

EXHIBIT J

LITHIUM HUB'S INFRINGEMENT ANALYSIS

U.S. Patent No. 9,412,994 – RELION RB100-HP

Independent Claims 1 and 14

Lithium Hub provides evidence of infringement of independent claims 1 and 14 of U.S. Patent No. 9,412,994 (hereinafter “the ’994 patent”) by RELION. In support thereof, Lithium Hub provides the following claim charts.

“Accused Products” as used herein refers to at least RELION RB100-HP and the Accused Products enumerated in the Complaint. These claim charts demonstrate RELION’s infringement by comparing each element of the asserted claims to corresponding components, aspects, and/or features of the Accused Products. These claim charts are not intended to constitute an expert report on infringement. These claim charts include information provided by way of example, and not by way of limitation.

Unless otherwise noted, LithiumHub contends that RELION directly infringes the ’994 patent in violation of 35 U.S.C. § 271(a) by selling, offering to sell, making, using, and/or importing the Accused Products. *See, e.g.*, RELION website (available at: <https://www.relionbattery.com/products/lithium/rb100-hp>). The following exemplary analysis demonstrates that infringement. Unless otherwise noted, LithiumHub further contends that the evidence below supports a finding of indirect infringement under 35 U.S.C. §§ 271(b) and/or (c), in conjunction with other evidence of liability under one or more of those subsections. RELION makes, uses, sells, imports, or offers for sale in the United States, or has made, used, sold, imported, or offered for sale in the past, without authority, or induces others to make, use, sell, import, or offer for sale in the United States, or has induced others to make, use, sell, import, or offer for sale in the past, without authority products, equipment, or services that infringe claims 1, 4-9, 11-16, 18-23 of the ’994 patent, including without limitation, the Accused Products.

Unless otherwise noted, LithiumHub believes and contends that each element of each claim asserted herein is literally met through RELION’s provision of the Accused Products. However, to the extent that RELION attempts to allege that any asserted claim element is not literally met, LithiumHub believes and contends that such elements are met under the doctrine of equivalents. More specifically, in its investigation and analysis of the Accused Products, LithiumHub did not identify any substantial differences between the elements of the patent claims and the corresponding features of the Accused Products, as set forth herein. In each instance, the identified feature of the Accused Products performs at least substantially the same function in substantially the same way to achieve substantially the same result as the corresponding claim element.

To the extent the chart of an asserted claim relies on evidence about certain specifically identified Accused Products, LithiumHub asserts that, on information and belief, any similarly functioning Accused Product also infringes the charted claim. LithiumHub reserves the right to amend this infringement analysis based on other products made, used, sold, imported, or offered for sale by RELION. LithiumHub further reserves the right to amend this infringement analysis by adding, subtracting, or otherwise modifying content in the “Accused Products” column of each chart.

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
Claim 1	
<p>[1p] A battery pack for driving an electrical device in a 12 volt to 120 volt operating system, said battery pack having a positive terminal and a negative terminal, comprising:</p>	<p>To the extent the preamble is limiting, the RELiON RB100-HP is a battery pack for driving an electrical device in a 12 volt to 120 volt operating system.</p>  <p>The image shows the cover of the RELiON Legacy Series User Manual. The cover is dark blue with a subtle hexagonal pattern. At the top, the word "RELiON" is written in a white, sans-serif font, with a green square containing the "Li" in the middle. Below it, the words "LEGACY SERIES" and "USER MANUAL" are written in large, white, bold, sans-serif letters.</p>

4.5. Battery Orientation

- Lithium batteries can be placed upright or on their sides.
- Do not install batteries in a zero-clearance compartment, overheating may result. Always leave at least 4" of space around all sides and top of battery.
- Keep any flammable/combustible material (e.g., paper, cloth, plastic, etc.) that may be ignited by heat, sparks, or flames at a minimum distance of two feet away from the batteries.
- Battery compartment and any material within two feet should be noncombustible.

4.6. Series or Parallel Connections

When connecting batteries in series or parallel, please follow these guidelines:

(1) Make sure each battery is within 50mV (0.05V) of each other before putting them in service. This will minimize the chance of imbalance between batteries. If your batteries get out of balance, the voltage of any battery is >50mV (0.05V) from another battery in the set, you should charge each battery individually to rebalance.

(2) Size batteries in parallel accordingly: The capacity of batteries (rated in amp hours) when connected in parallel is increased by the multiple of the batteries connected (2x, 3x, 4x, etc). However, the current ratings (discharge and charge) for parallel batteries is only increased by 75% of the multiple of the batteries connected (1.5x, 2.25x, 3x, etc).

(3) Batteries connected in series are best charged as individual batteries. Charging as a series bank can lead to imbalances and reduced runtime, requiring an occasional individual balancing charge.

(4) Please reference RELiON's LiFePO4 Charging Instructions document (available on our website at reliionbattery.com) for series and parallel charging.

Specifications for Batteries in Parallel				
Battery Quantity	v	2	3	4
Voltage	12.8	12.8	12.8	12.8
Capacity (Ah)	100	200	300	400
Max Continuous Discharge Current	100	150	225	300
Peak Discharge Current	200	300	450	600
Rec'd Charge Current	50	75	113	150
Max Charge Current	100	150	225	300

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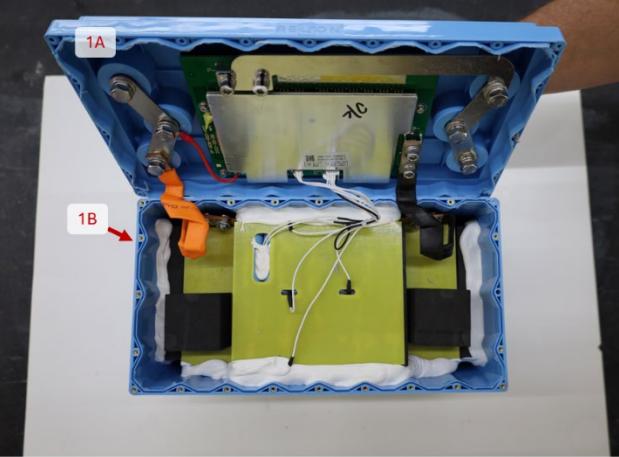
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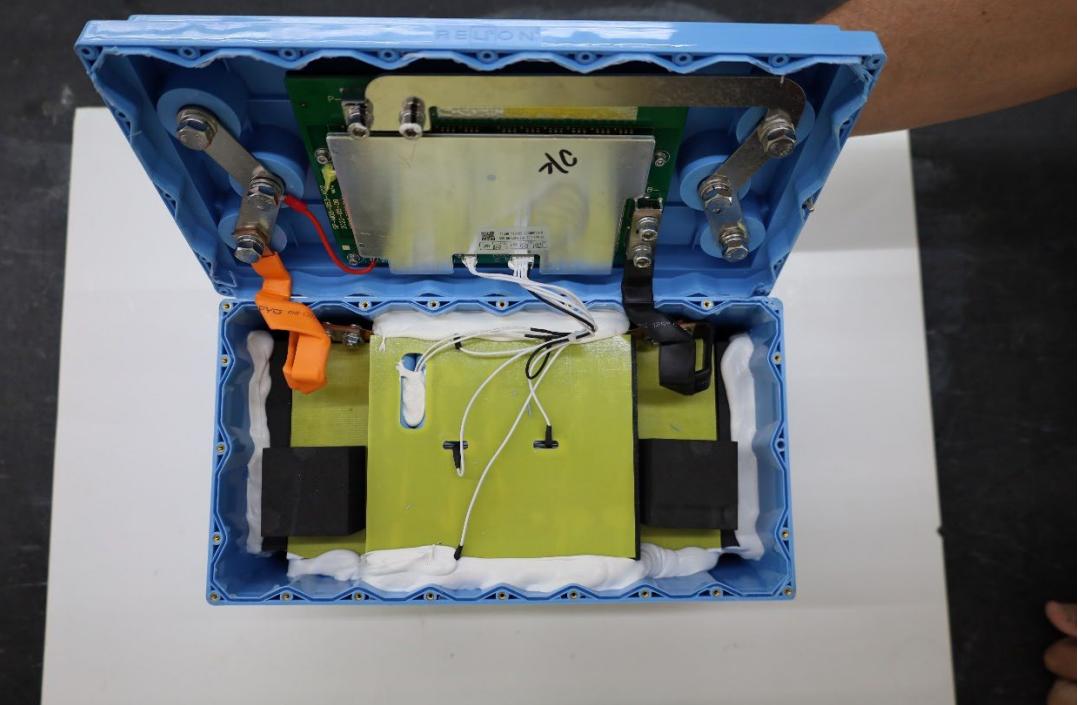
https://ceb8596f236225acd007-8e95328c173a04ed694af83ee4e24c15.ssl.cf5.rackcdn.com/user/Legacy-Series-User-Manual_122121.pdf (annotated).

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	 <p>The image shows the retail packaging for a RELiON RB100-HP battery. The box is blue with the RELiON logo in white and green. It specifies "LITHIUM IRON PHOSPHATE BATTERY LiFePO4", "RB100-HP", "12.8V", and "100Ah". A red box highlights the "12.8V" label. The box also includes "P/N: RB100-HP", "Capacity: 100Ah", "Voltage: 12.8V", "Energy: 1280Wh", "UN38.3", "CE", "Lithium", and "Made in China".</p>  <p>The image shows a stack of blue cylindrical batteries, likely the internal cells of the RB100-HP. They are arranged in two vertical columns, with orange and black connectors visible at the top.</p>

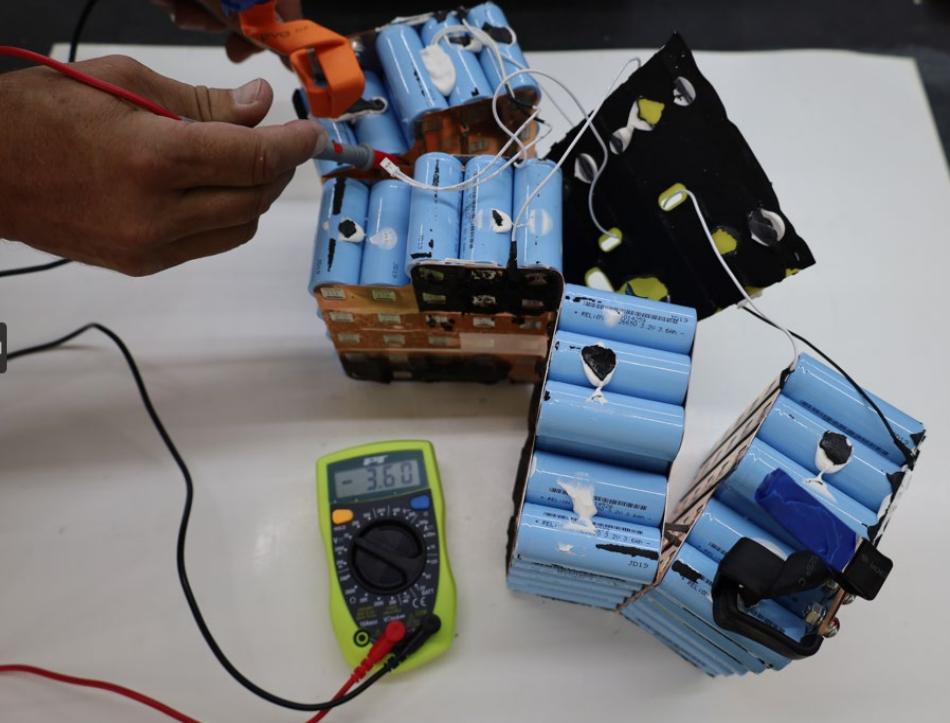
To the extent the preamble is limiting, the RELiON RB100-HP has a positive terminal (10) and a negative terminal (11).



US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
<p>[1a] a battery pack housing having at least a first portion and a mating second portion;</p>	<p>The RELION RB100-HP has a battery pack housing (1) with a first portion (1A) and a mating second portion (1B).</p>  
<p>[1b] at least one lithium-based rechargeable cell within said housing, each such cell having a positive pole and a negative pole;</p>	<p>The RELION RB100-HP comprises at least one lithium-based rechargeable cell within said housing.</p>

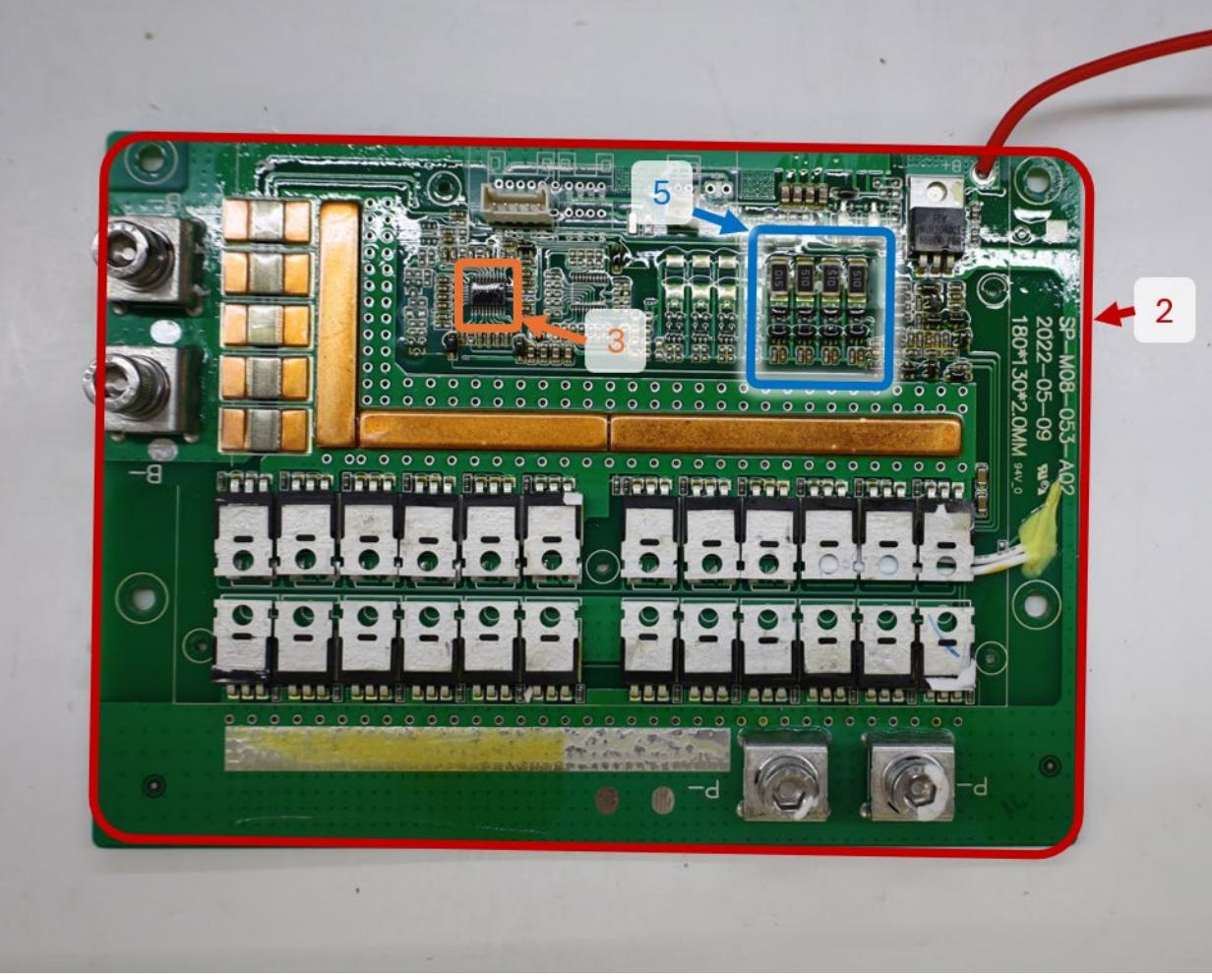
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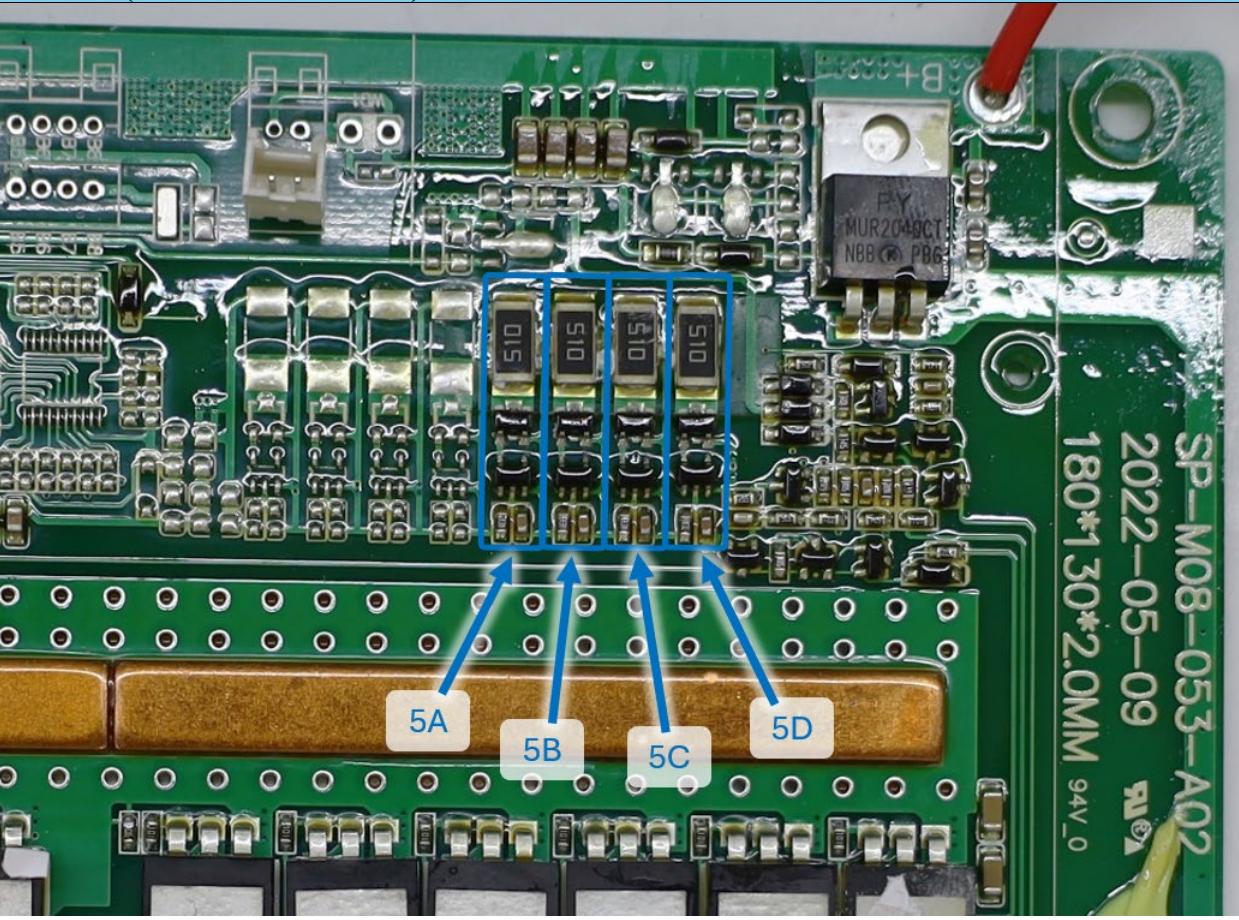
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	<p>Each such cell of the RELiON RB100-HP has a positive pole and a negative pole.</p>  <p>Additionally, for example, the polarity of each unit in a cell of the RELiON RB100-HP was demonstrated as having a positive pole and a negative pole by using a multimeter to measure a voltage potential across the positive pole and a negative pole of a cell.</p>

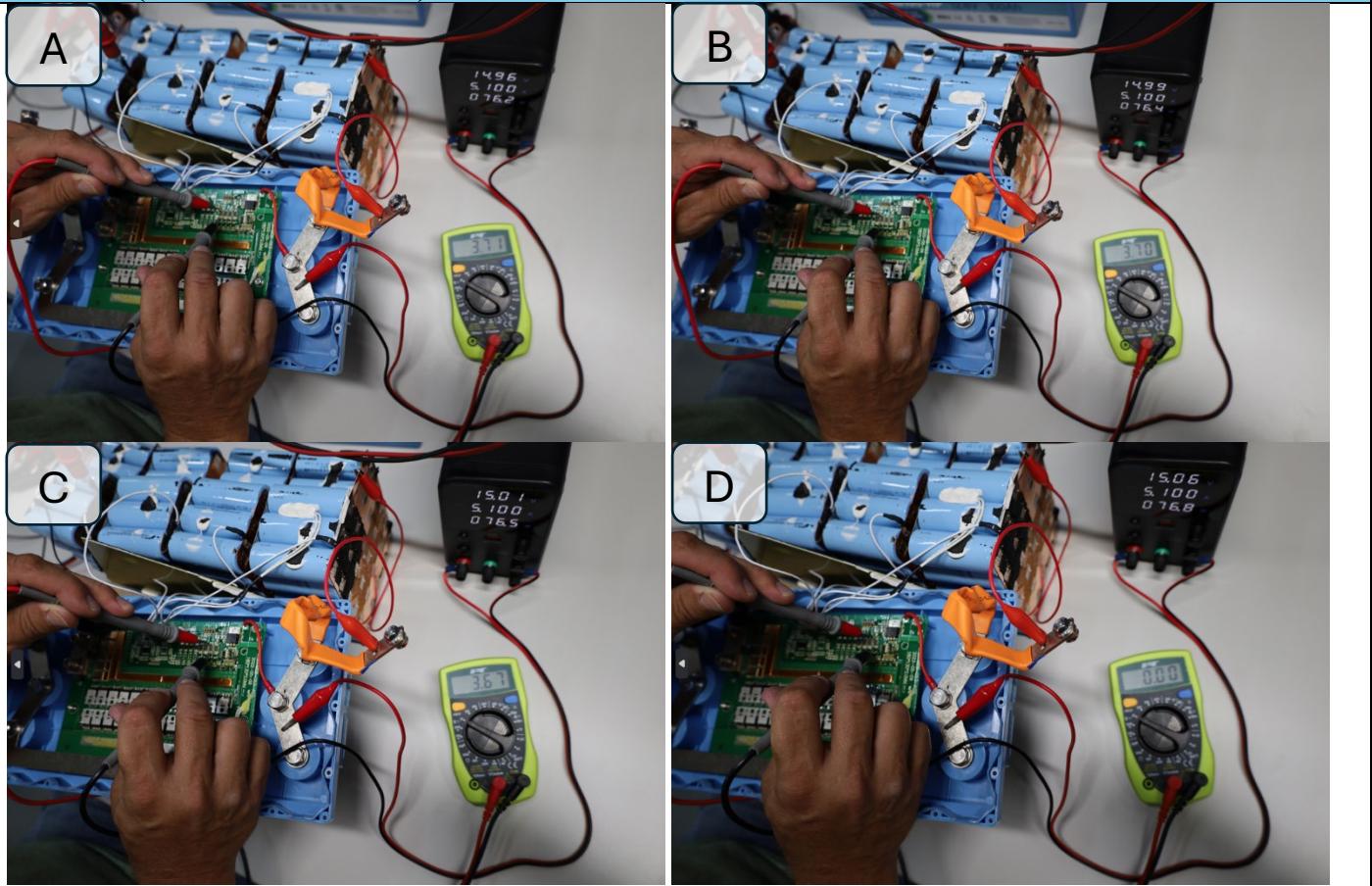
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
<p>[1c-i] a circuit board within said housing configured to balance each individual cell within said housing, and having a cutoff function incorporated therein,</p>	 <p>The RELiON RB100-HP comprises a circuit board (2) within said housing configured to balance (5) each individual cell within said housing (e.g., 5A-5D).</p>

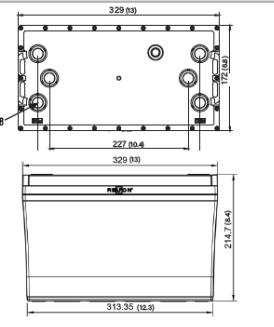
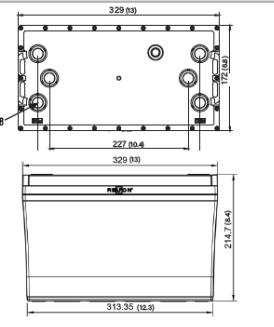
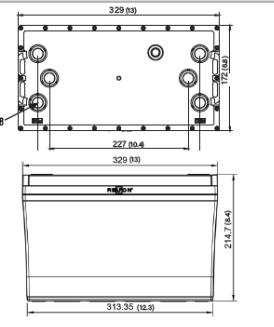
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)																																																																																
	<p style="text-align: right;">RELiON® DATA SHEET</p> <h1 style="text-align: center;">RB100-HP</h1> <p style="text-align: center;">Voltage: 12.8V Capacity: 100 Ah Energy: 1280 Wh Group: 31</p> <p style="text-align: center;">LITHIUM IRON PHOSPHATE BATTERY LiFePO4</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>ELECTRICAL SPECIFICATIONS</p> <table border="1"> <tbody> <tr><td>Nominal Voltage</td><td>12.8 V</td></tr> <tr><td>Nominal Capacity</td><td>100 Ah</td></tr> <tr><td>Reserve Capacity @ 25 A</td><td>240 min</td></tr> <tr><td>Resistance</td><td>≤30 mΩ @ 50% SOC</td></tr> <tr><td>Efficiency</td><td>99%</td></tr> <tr><td>Self Discharge</td><td><3% per Month</td></tr> <tr><td>Series Connections</td><td>No. 12V systems only.</td></tr> <tr><td>Parallel Connections</td><td>No. 1 battery only.</td></tr> </tbody> </table> <p>DISCHARGE SPECIFICATIONS</p> <table border="1"> <tbody> <tr><td>Maximum Continuous Discharge Current</td><td>100 A</td></tr> <tr><td>Maximum Discharge Current</td><td>800 Amps</td></tr> <tr><td>Lithium Marine Cranking Amp (MCA)</td><td>Up to 800 Amps for 8 seconds @ 20°F (-6.7°C)</td></tr> <tr><td>Discharge Over-Current Protection</td><td>1000 A ±100 A (2.2 ±1 ms)</td></tr> <tr><td>Recommended Low Voltage Disconnect</td><td>11.0 V</td></tr> <tr><td>Discharge Under-Voltage Protection</td><td>9.2 V (2.3 ±0.08 vpc) (4.2 ±0.5 s)</td></tr> <tr><td>Reconnect Voltage</td><td>10.0 V (2.5 ±0.1 vpc)</td></tr> <tr><td>Short Circuit Protection Response Time</td><td>200-600 µs</td></tr> </tbody> </table> <p>TEMPERATURE SPECIFICATIONS</p> <table border="1"> <tbody> <tr><td>Discharge Temperature</td><td>-4 to 140°F (-20 to 60°C)</td></tr> <tr><td>Charge Temperature*</td><td>32 to 130°F (0 to 55°C)</td></tr> <tr><td>Recommended Storage Temperature</td><td>23 to 95°F (-5 to 35°C)</td></tr> <tr><td>BMS High Temperature Cut-Off</td><td>176°F (80°C)</td></tr> <tr><td>Reconnect Temperature</td><td>122°F (50°C)</td></tr> </tbody> </table> <p><small>*Refer to charge currents below 32°F (0°C)</small></p> <p>MECHANICAL SPECIFICATIONS</p> <table border="1"> <tbody> <tr><td>Dimensions (L x W x H)</td><td>13 x 6.8 x 8.4" (329 x 172 x 214.7 mm)</td></tr> <tr><td>Weight</td><td>29.8 lbs (13.5 kg)</td></tr> <tr><td>Terminal Type</td><td>M8 x 1.25 x 12mm</td></tr> <tr><td>Terminal Torque</td><td>80 - 100 in-lbs (9 - 11 N-m)</td></tr> <tr><td>Case Material</td><td>ABS & PC blend (UL94-V0 flame rating)</td></tr> <tr><td>Enclosure Protection</td><td>IP67</td></tr> <tr><td>Cell Type - Chemistry</td><td>Cylindrical - LiFePO4</td></tr> </tbody> </table> <p style="text-align: center;">reliionbattery.com</p> <p style="text-align: right; font-size: small;">+1.803.547.7288 - TOLL FREE: (855) 931-2466 N85W12545 Westbrook Crossing - Menomonee Falls, Wisconsin 53051, USA +31 (0) 20 34 34 22 00 Snijdersbergweg 93 1105 AN - Amsterdam, The Netherlands +64 9 415 72 61 40-42 Apollo Drive - Albany, Auckland 0632, New Zealand</p> <p style="text-align: right; font-size: small;">RB100-HP DATA SHEET - 0619.24</p> </div> <div style="width: 45%;"> <p>CHARGE SPECIFICATIONS</p> <table border="1"> <tbody> <tr><td>Maximum Continuous Charge Current</td><td>5 A - 50 A</td></tr> <tr><td>Maximum Battery Charger Output</td><td>100 Amps</td></tr> <tr><td>Peak Charge Acceptance</td><td>165 Amps for up to 1 minute</td></tr> <tr><td>Maximum Engine Alternator Size</td><td>150 Amps</td></tr> <tr><td>Maximum Charge Current 14°F to 32°F (-10°C to 0°C)</td><td><0.1 C (10 Amps)</td></tr> <tr><td>Maximum Charge Current -4 to 14°F (-20 to -10°C)</td><td><0.05 C (5 Amps)</td></tr> <tr><td>Recommended Charge Voltage</td><td>14.4 - 14.8 V</td></tr> <tr><td>BMS Charge Voltage Cut-Off</td><td>15.4 V (3.85 ±0.025 vpc) (1 ±0.2 s)</td></tr> <tr><td>Reconnect Voltage</td><td>14.6 V (3.65 ±0.025 vpc)</td></tr> <tr><td>Balancing Voltage</td><td>14.4 V (3.6 ±0.025 vpc)</td></tr> </tbody> </table> <p>COMPLIANCE SPECIFICATIONS</p> <table border="1"> <tbody> <tr><td>Certifications</td><td>UN 38.3, CE & UKCA (battery) UL1642 (cells) (File# MH-162098) IEC62133 (cells)</td></tr> <tr><td>Shipping Classification</td><td>UN 3480, CLASS 9</td></tr> </tbody> </table> <p>DIMENSIONAL SPECIFICATIONS</p> </div> </div>	Nominal Voltage	12.8 V	Nominal Capacity	100 Ah	Reserve Capacity @ 25 A	240 min	Resistance	≤30 mΩ @ 50% SOC	Efficiency	99%	Self Discharge	<3% per Month	Series Connections	No. 12V systems only.	Parallel Connections	No. 1 battery only.	Maximum Continuous Discharge Current	100 A	Maximum Discharge Current	800 Amps	Lithium Marine Cranking Amp (MCA)	Up to 800 Amps for 8 seconds @ 20°F (-6.7°C)	Discharge Over-Current Protection	1000 A ±100 A (2.2 ±1 ms)	Recommended Low Voltage Disconnect	11.0 V	Discharge Under-Voltage Protection	9.2 V (2.3 ±0.08 vpc) (4.2 ±0.5 s)	Reconnect Voltage	10.0 V (2.5 ±0.1 vpc)	Short Circuit Protection Response Time	200-600 µs	Discharge Temperature	-4 to 140°F (-20 to 60°C)	Charge Temperature*	32 to 130°F (0 to 55°C)	Recommended Storage Temperature	23 to 95°F (-5 to 35°C)	BMS High Temperature Cut-Off	176°F (80°C)	Reconnect Temperature	122°F (50°C)	Dimensions (L x W x H)	13 x 6.8 x 8.4" (329 x 172 x 214.7 mm)	Weight	29.8 lbs (13.5 kg)	Terminal Type	M8 x 1.25 x 12mm	Terminal Torque	80 - 100 in-lbs (9 - 11 N-m)	Case Material	ABS & PC blend (UL94-V0 flame rating)	Enclosure Protection	IP67	Cell Type - Chemistry	Cylindrical - LiFePO4	Maximum Continuous Charge Current	5 A - 50 A	Maximum Battery Charger Output	100 Amps	Peak Charge Acceptance	165 Amps for up to 1 minute	Maximum Engine Alternator Size	150 Amps	Maximum Charge Current 14°F to 32°F (-10°C to 0°C)	<0.1 C (10 Amps)	Maximum Charge Current -4 to 14°F (-20 to -10°C)	<0.05 C (5 Amps)	Recommended Charge Voltage	14.4 - 14.8 V	BMS Charge Voltage Cut-Off	15.4 V (3.85 ±0.025 vpc) (1 ±0.2 s)	Reconnect Voltage	14.6 V (3.65 ±0.025 vpc)	Balancing Voltage	14.4 V (3.6 ±0.025 vpc)	Certifications	UN 38.3, CE & UKCA (battery) UL1642 (cells) (File# MH-162098) IEC62133 (cells)	Shipping Classification	UN 3480, CLASS 9
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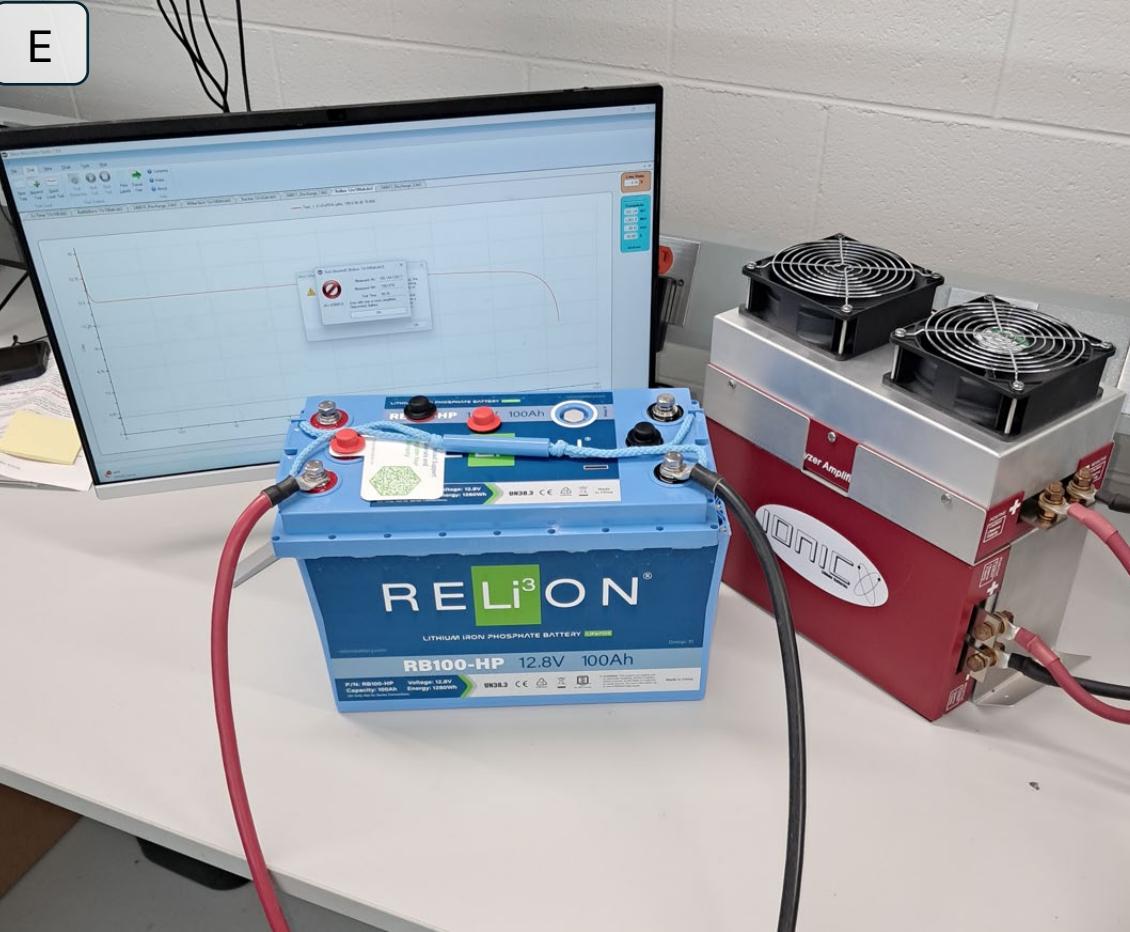
https://ceb8596f236225acd007-8e95328c173a04ed694af83ee4e24c15.ssl.cf5.rackcdn.com/docs/product/RELiON-Data-Sheet_RB100-HP.pdf (annotated).

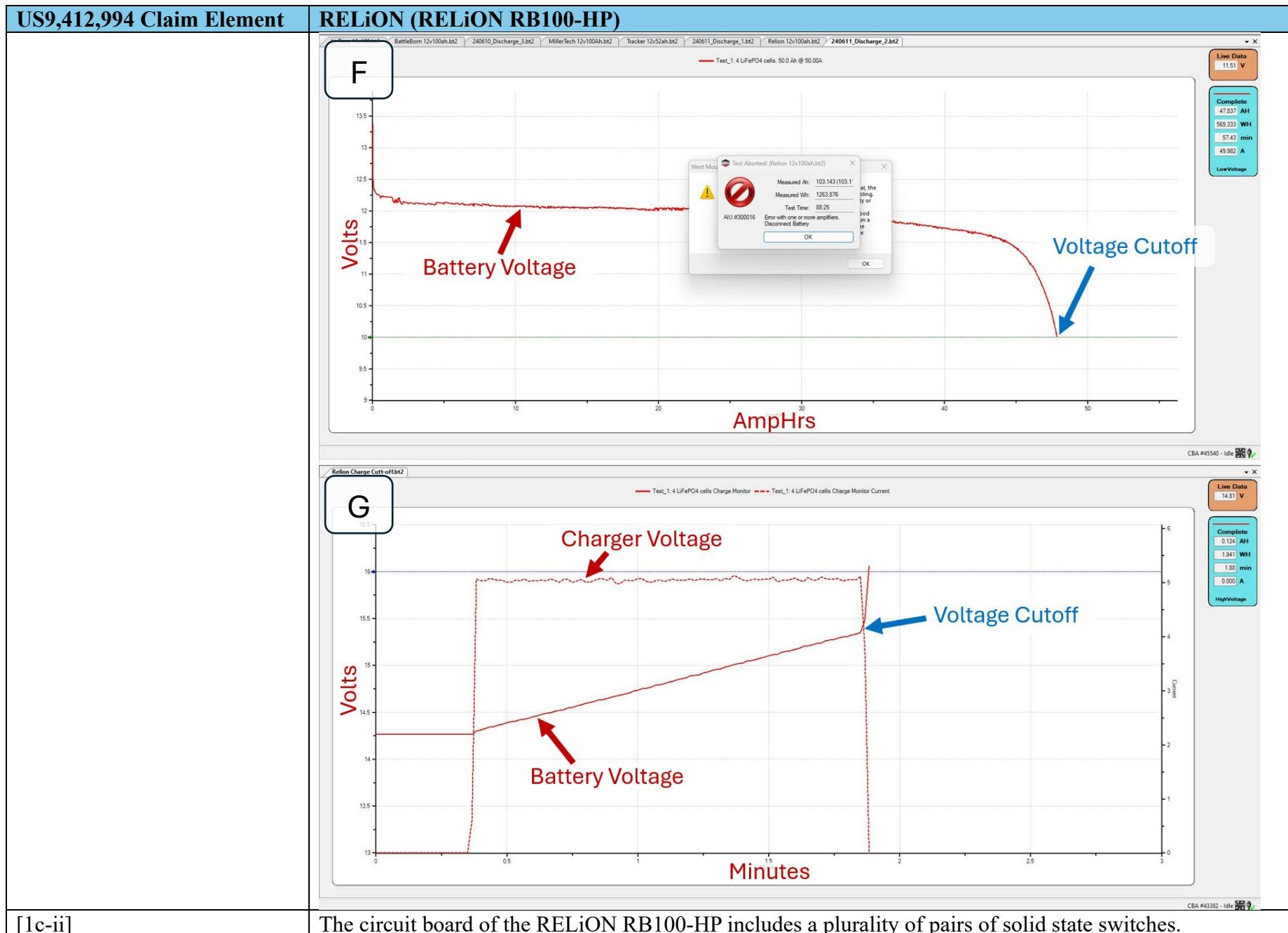
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	 <p>For example, as demonstrated by using a multimeter and testing the voltage across each of the cell balancing circuits 5A-5D when one of the cells were discharged relative to the remaining three cells of the RELiON RB100-HP a voltage across three of the respective balancing circuits was observed (see photos A-C below) while the remaining balancing circuits remained inactive (see photos D below).</p>

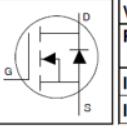
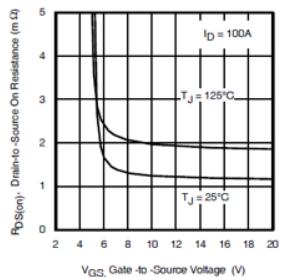
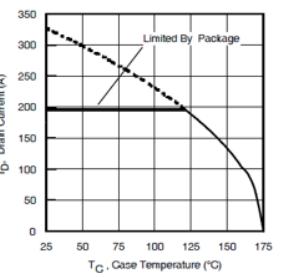
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
 <p>The RELiON RB100-HP comprises a circuit board having a cutoff function incorporated therein.</p>	

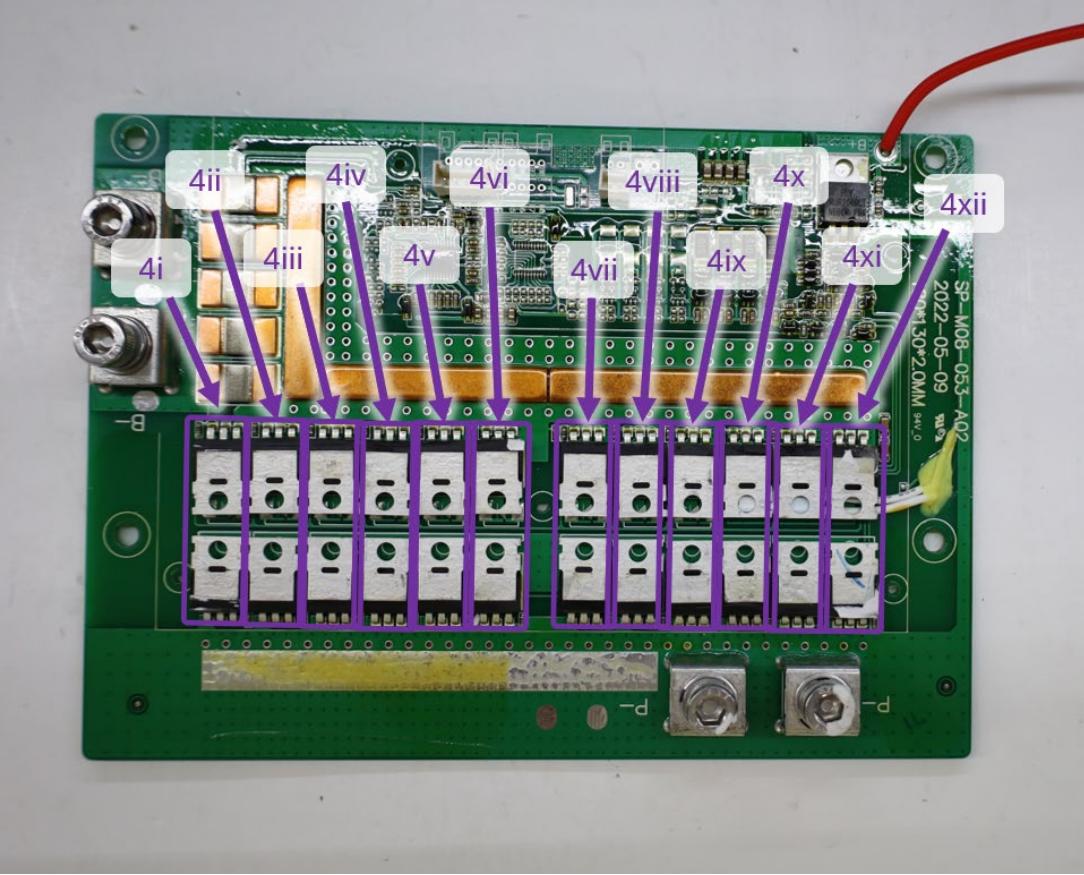
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	<div style="text-align: center;">  <p>RELiON® DATA SHEET</p> <h1>RB100-HP</h1> <p>Voltage: 12.8V Capacity: 100 Ah Energy: 1280 Wh Group: 31</p> <p>LITHIUM IRON PHOSPHATE BATTERY LiFePO4</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="padding: 5px;">ELECTRICAL SPECIFICATIONS</td> <td colspan="2" style="padding: 5px;">CHARGE SPECIFICATIONS</td> </tr> <tr> <td style="padding: 5px;">Nominal Voltage</td><td style="padding: 5px;">12.8 V</td> <td style="padding: 5px;">Maximum Continuous Charge Current</td><td style="padding: 5px;">5 A - 50 A</td> </tr> <tr> <td style="padding: 5px;">Nominal Capacity</td><td style="padding: 5px;">100 Ah</td> <td style="padding: 5px;">Maximum Battery Charger Output</td><td style="padding: 5px;">100 Amps</td> </tr> <tr> <td style="padding: 5px;">Reserve Capacity @ 25 A</td><td style="padding: 5px;">240 min</td> <td style="padding: 5px;">Peak Charge Acceptance</td><td style="padding: 5px;">165 Amps for up to 1 minute</td> </tr> <tr> <td style="padding: 5px;">Resistance</td><td style="padding: 5px;">≤30 mΩ @ 50% SOC</td> <td style="padding: 5px;">Maximum Engine Alternator Size</td><td style="padding: 5px;">150 Amps</td> </tr> <tr> <td style="padding: 5px;">Efficiency</td><td style="padding: 5px;">99%</td> <td style="padding: 5px;">Maximum Charge Current</td><td style="padding: 5px;">14° to 32°F (-10°C to 0°C)</td> </tr> <tr> <td style="padding: 5px;">Self Discharge</td><td style="padding: 5px;"><3% per Month</td> <td style="padding: 5px;">-4 to 14°F (-20 to -10°C)</td><td style="padding: 5px;"><0.1 C (10 Amps)</td> </tr> <tr> <td style="padding: 5px;">Series Connections</td><td style="padding: 5px;">No. 12V systems only.</td> <td style="padding: 5px;">-4 to 14°F (-20 to -10°C)</td><td style="padding: 5px;"><0.05 C (5 Amps)</td> </tr> <tr> <td style="padding: 5px;">Parallel Connections</td><td style="padding: 5px;">No. 1 battery only.</td> <td style="padding: 5px;">Recommended Charge Voltage</td><td style="padding: 5px;">14.4 - 14.8 V</td> </tr> <tr> <td colspan="2" style="padding: 5px;">DISCHARGE SPECIFICATIONS</td> <td colspan="2" style="padding: 5px;">BMS Charge Voltage Cut-Off</td> </tr> <tr> <td style="padding: 5px;">Maximum Continuous Discharge Current</td><td style="padding: 5px;">100 A</td> <td style="padding: 5px;">15.4 V (3.85 ± 0.025 vpc) (1 ± 0.2 s)</td><td style="padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">Maximum Discharge Current</td><td style="padding: 5px;">800 Amps</td> <td style="padding: 5px;">Reconnect Voltage</td><td style="padding: 5px;">14.6 V (3.65 ± 0.05 vpc)</td> </tr> <tr> <td style="padding: 5px;">Lithium Marine Cranking Amp (MCA)</td><td style="padding: 5px;">Up to 800 Amps for 8 seconds @ 20°F (-6.7°C)</td> <td style="padding: 5px;">Balancing Voltage</td><td style="padding: 5px;">14.4 V (3.6 ± 0.025 vpc)</td> </tr> <tr> <td style="padding: 5px;">Discharge Over-Current Protection</td><td style="padding: 5px;">1000 A ±100 A (2.2 ± 1 ms)</td> <td colspan="2" style="padding: 5px;">COMPLIANCE SPECIFICATIONS</td> </tr> <tr> <td style="padding: 5px;">Recommended Low Voltage Disconnect</td><td style="padding: 5px;">11.0 V</td> <td style="padding: 5px;">Certifications</td><td style="padding: 5px;">UN 38.3, CE & UKCA (battery) UL1642 (cells) (File# MH-162098) IEC62133 (cells)</td> </tr> <tr> <td style="padding: 5px;">Discharge Under-Voltage Protection</td><td style="padding: 5px;">9.2 V (2.3 ± 0.08 vpc) (4.2 ± 0.5 s)</td> <td style="padding: 5px;">Shipping Classification</td><td style="padding: 5px;">UN 3480, CLASS 9</td> </tr> <tr> <td style="padding: 5px;">Reconnect Voltage</td><td style="padding: 5px;">10.0 V (2.5 ± 0.1 vpc)</td> <td colspan="2" style="padding: 5px;">DIMENSIONAL SPECIFICATIONS</td> </tr> <tr> <td style="padding: 5px;">Short Circuit Protection Response Time</td><td style="padding: 5px;">200-600 µs</td> <td colspan="2" style="padding: 5px;">  <p>Technical drawing showing the dimensions of the RB100-HP battery. 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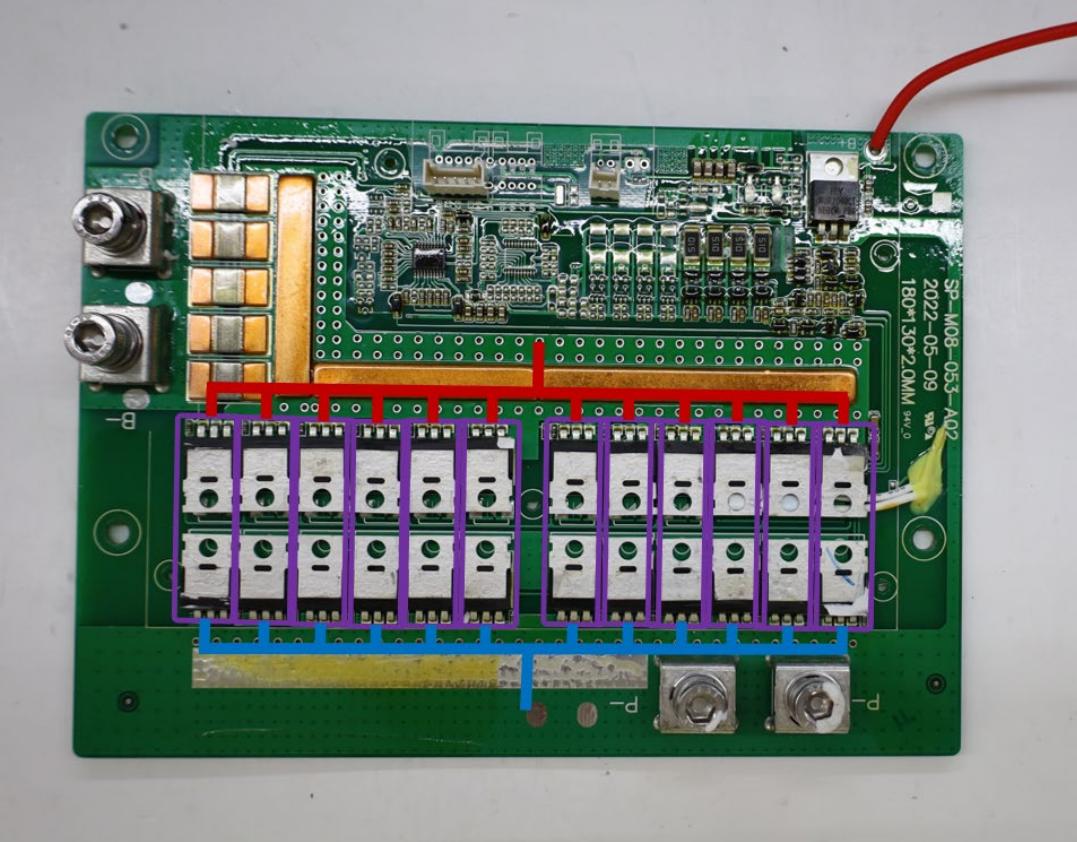
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	<p>For example, as demonstrated by connecting the battery terminals of the RELiON RB100-HP to a computerized battery analyzer (see photo E below), the cutoff functionality is demonstrated by the termination of electrical current when the RELiON RB100-HP was discharged below its rated voltage (see photo F below). Similarly, the cutoff functionality is also demonstrated by the termination of electrical current when the RELiON RB100-HP was charged above its rated voltage (see photo G below).</p> <p>E</p> 



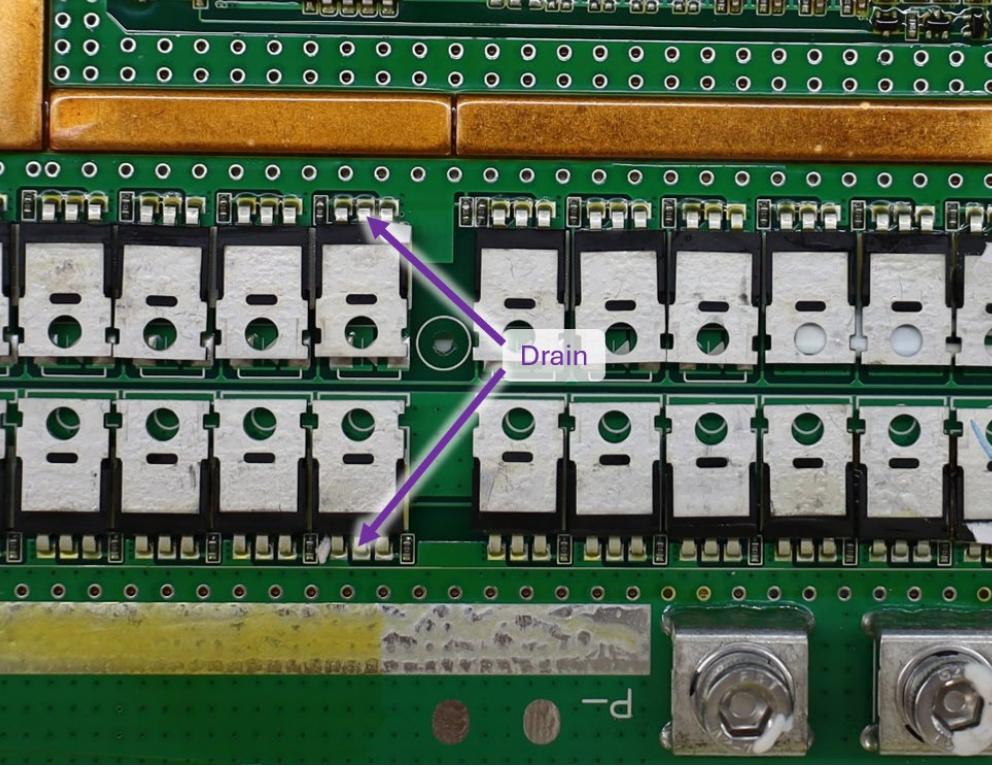
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
<p>said circuit board including a plurality of pairs of solid state switches with each pair of solid state switches connected in a parallel configuration to another pair of solid state switches,</p>	

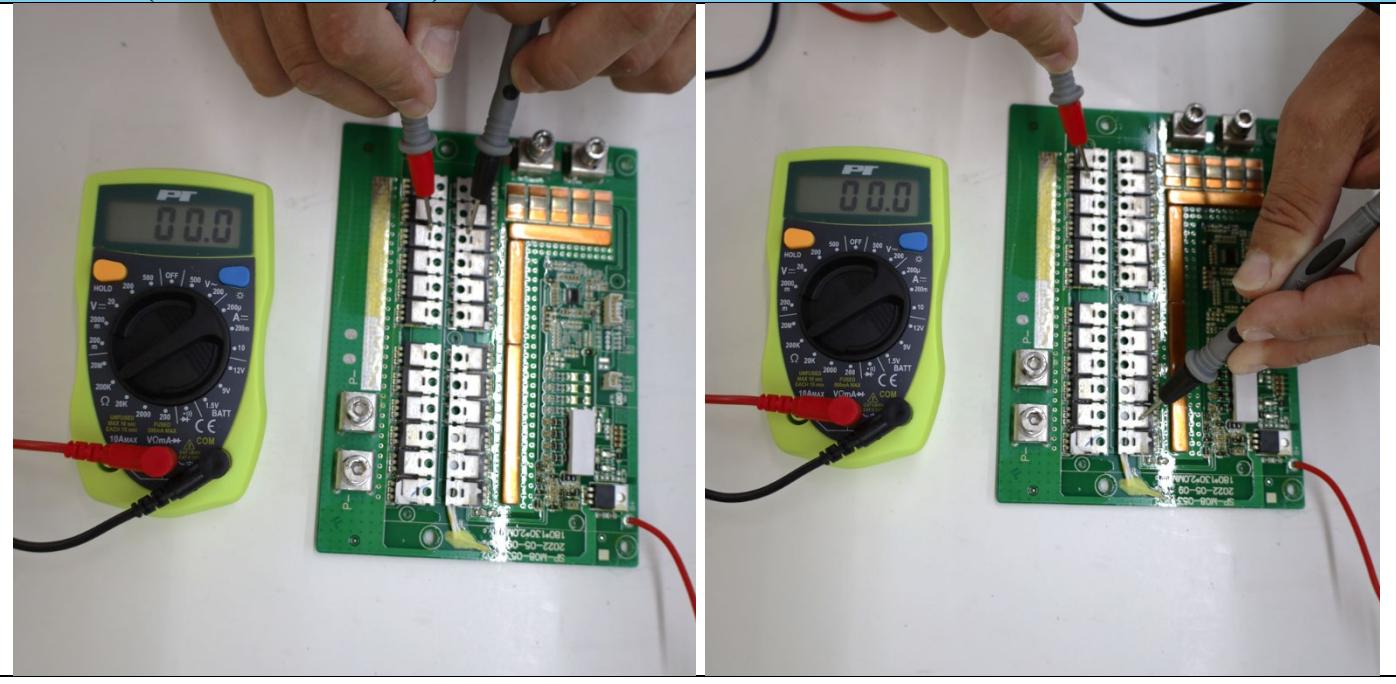
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	<p>International IR Rectifier</p> <p>Strong/RFET™ IRFB7434PbF HEXFET® Power MOSFET</p> <p>Applications</p> <ul style="list-style-type: none"> Brushed Motor drive applications BLDC Motor drive applications Battery powered circuits Half-bridge and full-bridge topologies Synchronous rectifier applications Resonant mode power supplies OR-ing and redundant power switches DC/DC and AC/DC converters DC/AC Inverters <p>Benefits</p> <ul style="list-style-type: none"> Improved Gate, Avalanche and Dynamic dV/dt Ruggedness Fully Characterized Capacitance and Avalanche SOA Enhanced body diode dV/dt and dI/dt Capability Lead-Free <p>PD-96436</p> <p>IRFB7434PbF</p> <p>Symbol:</p>  <p>Table:</p> <table border="1"> <thead> <tr> <th></th> <th>V_{DSS}</th> <th>40V</th> </tr> </thead> <tbody> <tr> <td>R_{DSON} typ.</td> <td>1.25mΩ</td> <td></td> </tr> <tr> <td>max.</td> <td>1.6mΩ</td> <td></td> </tr> <tr> <td>I_D (Silicon Limited)</td> <td>317A</td> <td>Ω</td> </tr> <tr> <td>I_D (Package Limited)</td> <td>195A</td> <td></td> </tr> </tbody> </table> <p>Image:</p>  <p>Pinout:</p> <table border="1"> <thead> <tr> <th>G</th> <th>D</th> <th>S</th> </tr> </thead> <tbody> <tr> <td>Gate</td> <td>Drain</td> <td>Source</td> </tr> </tbody> </table> <p>Ordering Information</p> <table border="1"> <thead> <tr> <th rowspan="2">Base part number</th> <th rowspan="2">Package Type</th> <th colspan="2">Standard Pack</th> <th rowspan="2">Complete Part Number</th> </tr> <tr> <th>Form</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td>IRFB7434PbF</td> <td>TO-220</td> <td>Tube</td> <td>50</td> <td>IRFB7434PbF</td> </tr> </tbody> </table> <p>Figure 1: Typical On-Resistance vs. Gate Voltage</p>  <p>Figure 2: Maximum Drain Current vs. Case Temperature</p>  <p>Fig 1. Typical On-Resistance vs. Gate Voltage www.irf.com</p> <p>Fig 2. Maximum Drain Current vs. Case Temperature 1 04/2012</p> <p>http://www.irf.ru/pdf/irfb7434pbf.pdf (annotated).</p> <p>The solid state switches of the RELiON RB100-HP are arranged in pairs (e.g., 4i-4xii) with each pair of solid state switches connected in a parallel configuration to another pair of solid state switches.</p>		V_{DSS}	40V	R_{DSON} typ.	1.25mΩ		max.	1.6mΩ		I_D (Silicon Limited)	317A	Ω	I_D (Package Limited)	195A		G	D	S	Gate	Drain	Source	Base part number	Package Type	Standard Pack		Complete Part Number	Form	Quantity	IRFB7434PbF	TO-220	Tube	50	IRFB7434PbF
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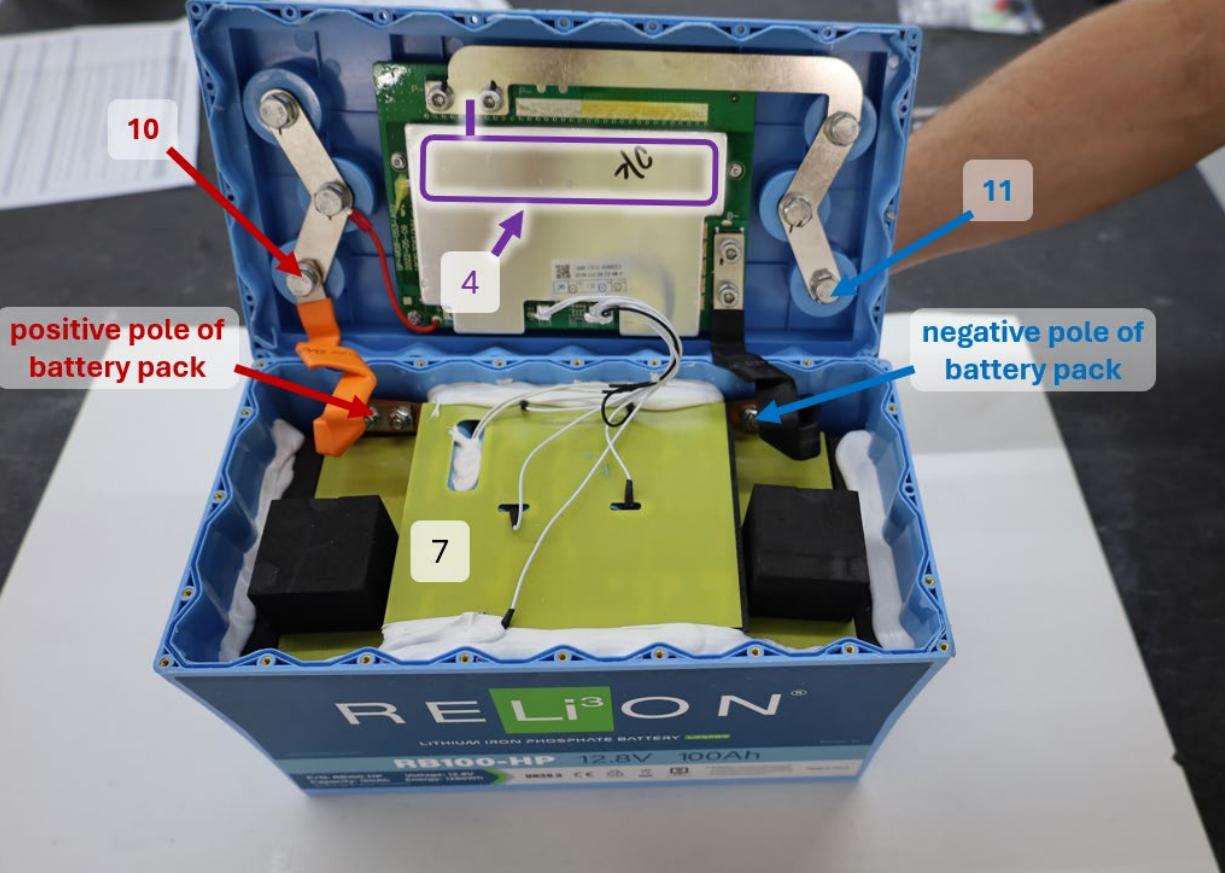
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	

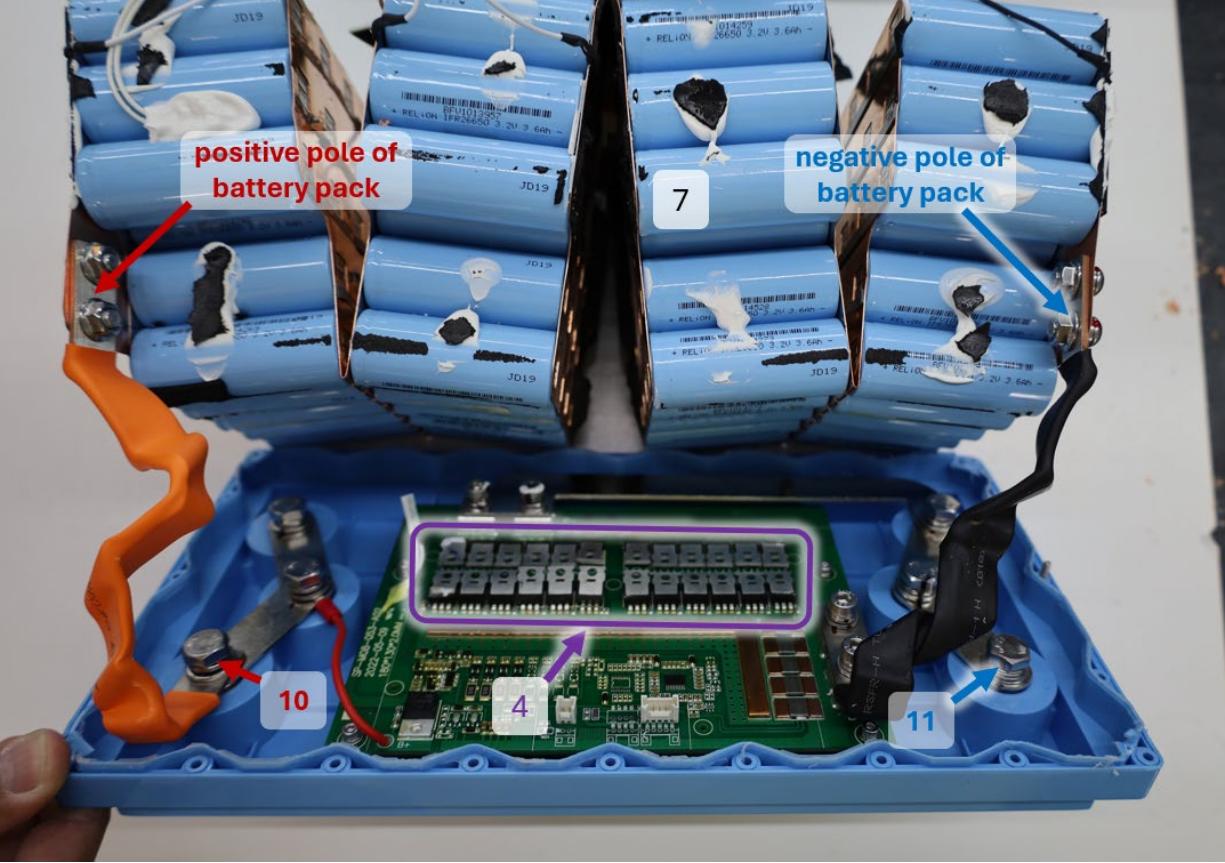
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
<p>[1c-iii] each switch having a source and a drain, the switches of a pair of solid state switches being configured such that either the drains of the switches are connected or the sources of the switches are connected; and</p>	 <p>Each switch of the RELiON RB100-HP has a source (i.e., "S") and a drain (i.e., "D").</p>

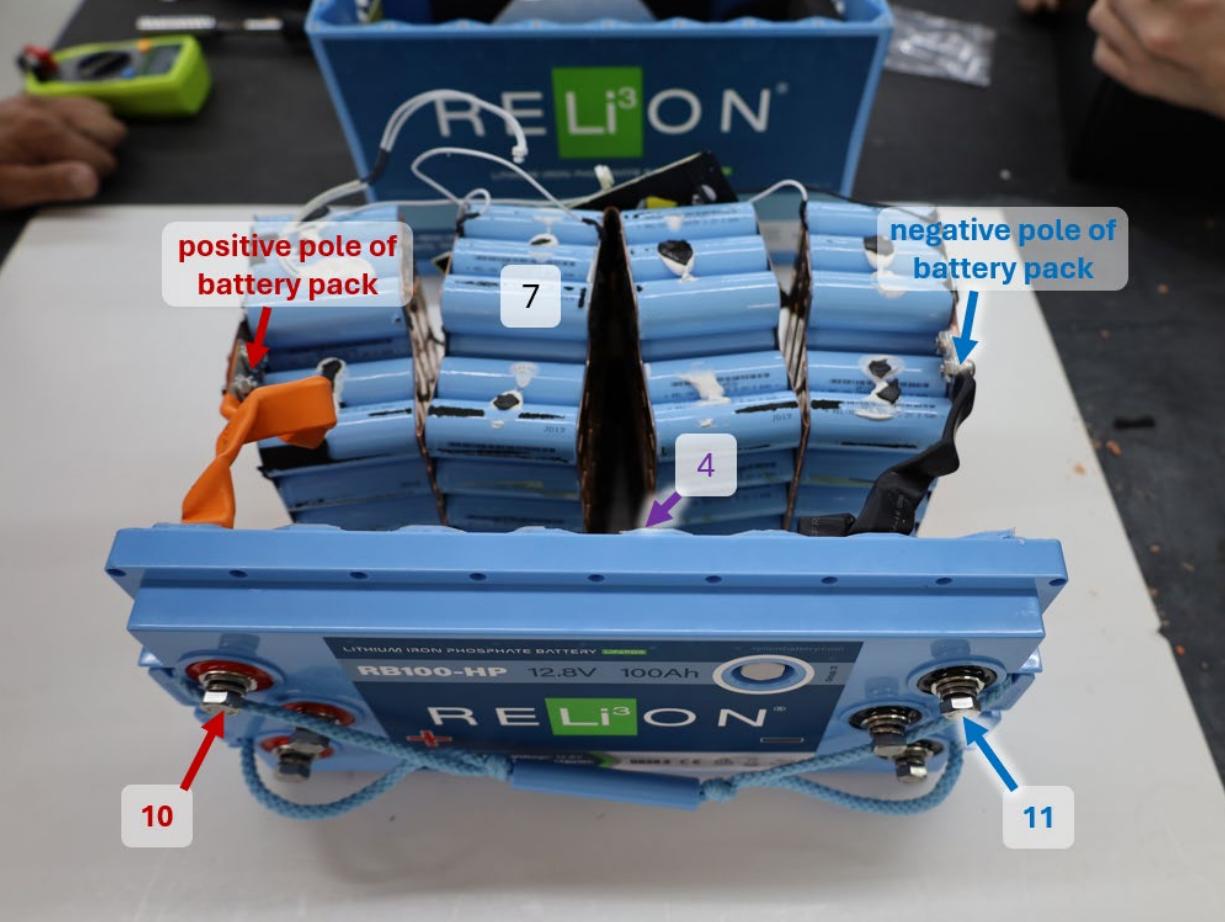
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US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	 <p>For example, as demonstrated by testing the electrical continuity using a multimeter, the drains of the switches of the RELiON RB100-HP are connected, as shown by the nominal resistance measured between the drains of opposed MOSFETs.</p>

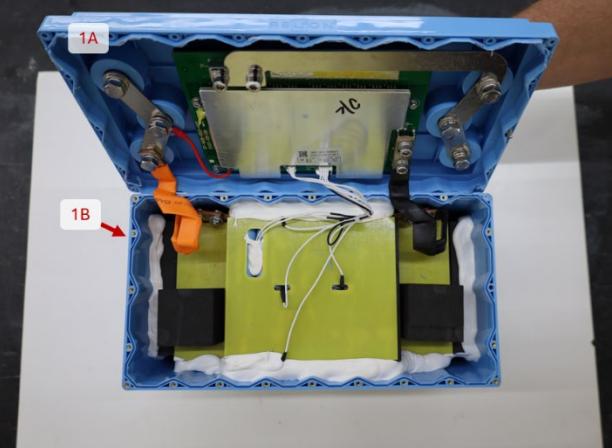
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
<p>[1d] said parallel configuration of the plurality of solid state switches being connected in series with said one or more cells between said positive and negative terminals of the battery pack.</p>	

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	 <p>positive pole of battery pack</p> <p>negative pole of battery pack</p> <p>4</p> <p>7</p> <p>10</p> <p>11</p>

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	

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Claim 14	
<p>[14p] A battery pack for driving an electrical device in a 1 volt to 120 volt operating system, said battery pack comprising:</p>	<p>To the extent the preamble is limiting, the RELiON RB100-HP is a battery pack for driving an electrical device in a 1 volt to 120 volt operating system.</p>

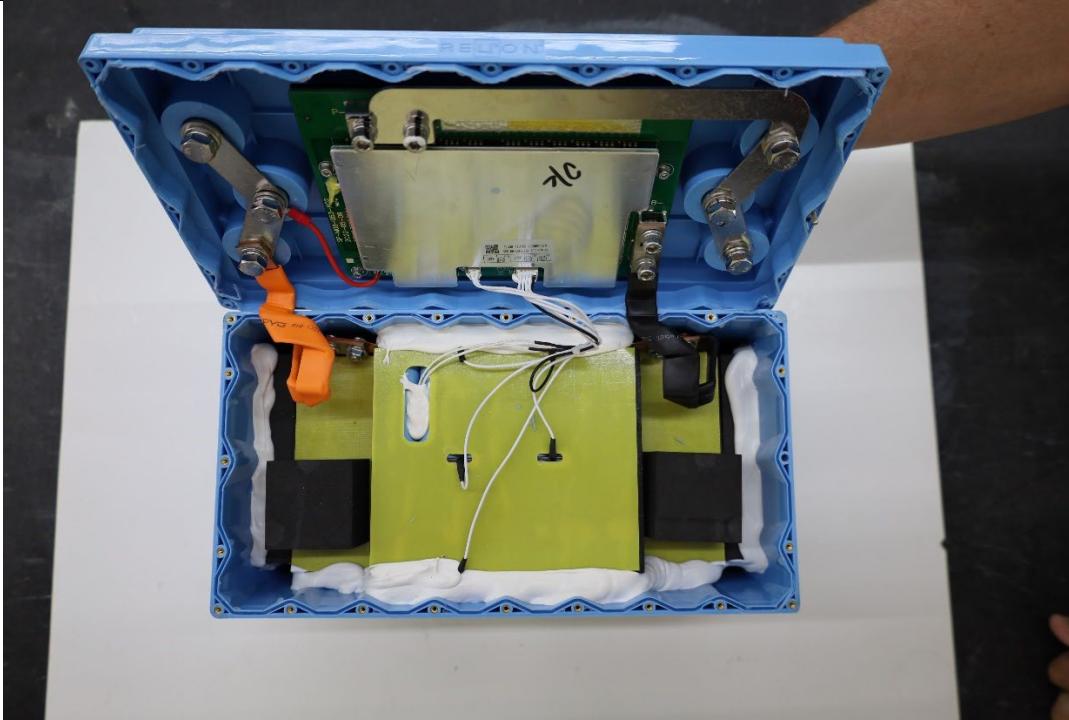
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	 <p>The image shows the cover of the RELiON Legacy Series User Manual. The cover is dark blue with a green rectangular logo in the center containing the text 'RELiON' with a registered trademark symbol. Below the logo, the text 'LEGACY SERIES' and 'USER MANUAL' is printed in large, white, sans-serif capital letters. The background of the cover features a faint, repeating pattern of white molecular or chemical structures.</p> <p>https://ceb8596f236225acd007-8e95328c173a04ed694af83ee4e24c15.ssl.cf5.rackcdn.com/user/Legacy-Series-User-Manual_122121.pdf (annotated).</p>	<p>4.5. Battery Orientation</p> <ul style="list-style-type: none"> • Lithium batteries can be placed upright or on their sides. • Do not install batteries in a zero-clearance compartment, overheating may result. Always leave at least 4" of space around all sides and top of battery. • Keep any flammable/combustible material (e.g., paper, cloth, plastic, etc.) that may be ignited by heat, sparks, or flames at a minimum distance of two feet away from the batteries. • Battery compartment and any material within two feet should be noncombustible. <p>4.6. Series or Parallel Connections</p> <p>When connecting batteries in series or parallel, please follow these guidelines:</p> <ol style="list-style-type: none"> (1) Make sure each battery is within 50mV (0.05V) of each other before putting them in service. This will minimize the chance of imbalance between batteries. If your batteries get out of balance, the voltage of any battery is >50mV (0.05V) from another battery in the set, you should charge each battery individually to rebalance. (2) Size batteries in parallel accordingly: The capacity of batteries (rated in amp-hours) when connected in parallel is increased by the multiple of the batteries connected (2x, 3x, 4x, etc). However, the current ratings (discharge and charge) for parallel batteries is only increased by 75% of the multiple of the batteries connected (1.5x, 2.25x, 3x, etc). (3) Batteries connected in series are best charged as individual batteries. Charging as a series bank can lead to imbalances and reduced runtime, requiring an occasional individual balancing charge. (4) Please reference RELiON's LiFePO4 Charging Instructions document (available on our website at reliionbattery.com) for series and parallel charging. <table border="1"> <thead> <tr> <th colspan="5">Specifications for Batteries in Parallel</th> </tr> <tr> <th>Battery Quantity</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>Voltage</td> <td>12.8</td> <td>12.8</td> <td>12.8</td> <td>12.8</td> </tr> <tr> <td>Capacity (Ah)</td> <td>100</td> <td>200</td> <td>300</td> <td>400</td> </tr> <tr> <td>Max Continuous Discharge Current</td> <td>100</td> <td>150</td> <td>225</td> <td>300</td> </tr> <tr> <td>Peak Discharge Current</td> <td>200</td> <td>300</td> <td>450</td> <td>600</td> </tr> <tr> <td>Rec'd Charge Current</td> <td>50</td> <td>75</td> <td>113</td> <td>150</td> </tr> <tr> <td>Max Charge Current</td> <td>100</td> <td>150</td> <td>225</td> <td>300</td> </tr> </tbody> </table> <p>RELIONBATTERY.COM • 855-931-2466</p> <p>9</p>	Specifications for Batteries in Parallel					Battery Quantity	1	2	3	4	Voltage	12.8	12.8	12.8	12.8	Capacity (Ah)	100	200	300	400	Max Continuous Discharge Current	100	150	225	300	Peak Discharge Current	200	300	450	600	Rec'd Charge Current	50	75	113	150	Max Charge Current	100	150	225	300
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US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	 <p>The image shows the front of a RELiON RB100-HP battery box. The box is blue with the RELiON logo in white and green. The text "RELiON" is prominently displayed in the center. Below it, it says "LITHIUM IRON PHOSPHATE BATTERY LiFePO4". The model "RB100-HP" is at the bottom left, followed by "12.8V" and "100Ah" in a red box. Other text on the box includes "P/N: RB100-HP", "Capacity: 100Ah", "Voltage: 12.8V", "Energy: 1280Wh", "UN38.3", "CE", "Lithium", and "Made in China".</p>
<p>[14a] a battery pack housing having at least first and second mating portions, said housing having a positive terminal and a negative terminal;</p>	<p>The RELiON RB100-HP includes a battery pack housing (1) having at least first (1A) and second mating portions (1B).</p>  <p>The image shows the same RELiON RB100-HP battery box as above, but with red arrows pointing to the top and bottom edges. The top edge is labeled "1A" and the bottom edge is labeled "1B".</p>  <p>The image shows the open RELiON RB100-HP battery housing. The interior is blue and contains several blue cylindrical cells. A red arrow points to the positive terminal (10) and a red arrow points to the negative terminal (11). The housing is labeled "1A" at the top and "1B" at the bottom.</p> <p>The housing of the RELiON RB100-HP has a positive terminal (10) and a negative terminal (11).</p>

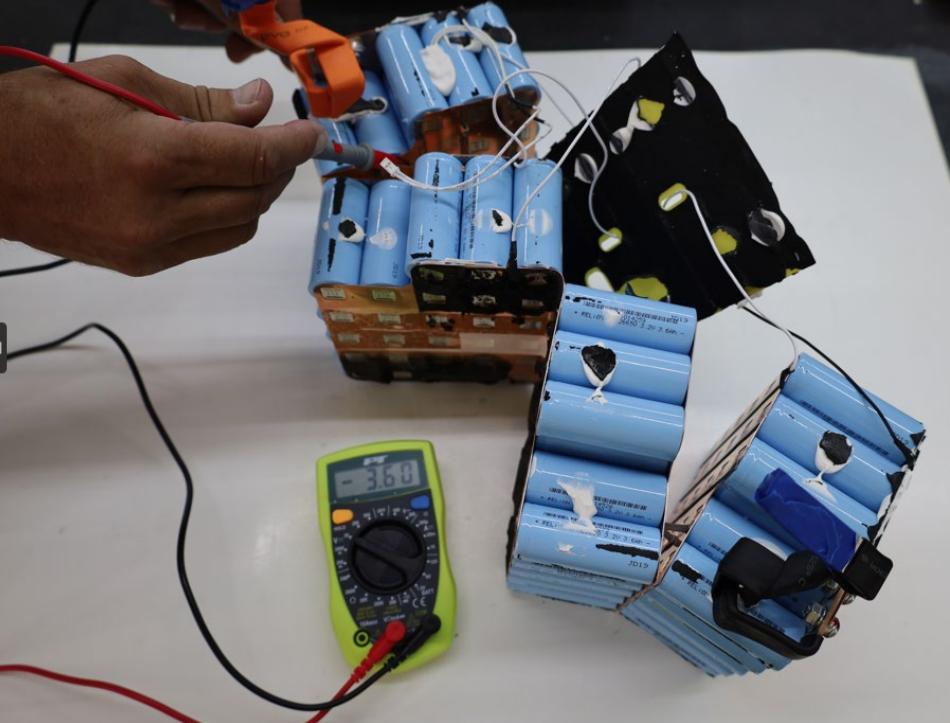
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	
<p>[14b] at least one lithium-based rechargeable cell within said housing, said cell having a positive pole and a negative pole;</p>	<p>The RELiON RB100-HP includes at least one lithium-based rechargeable cell within said housing.</p>

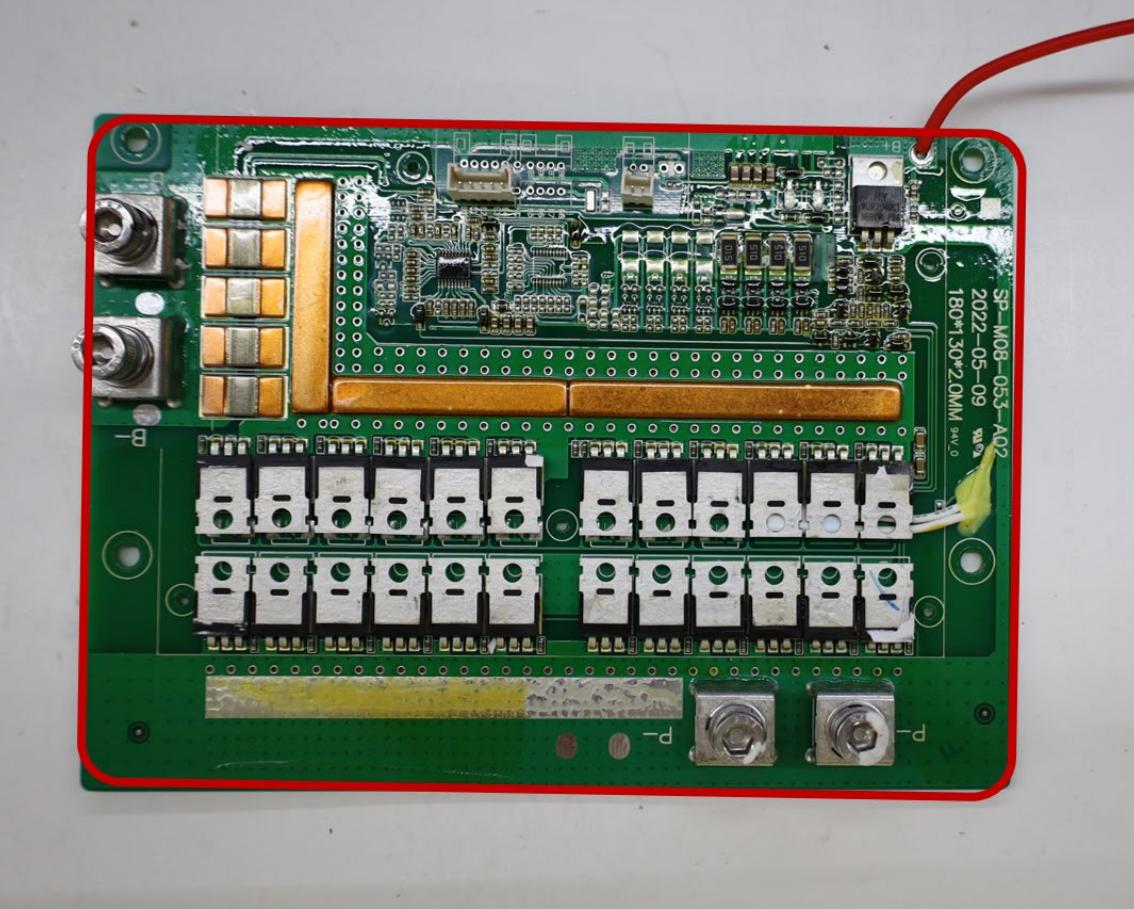
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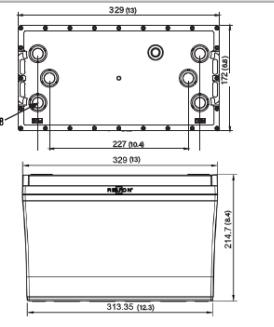
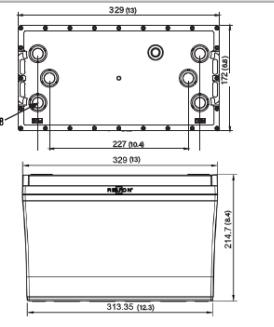
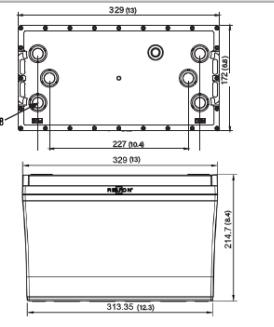
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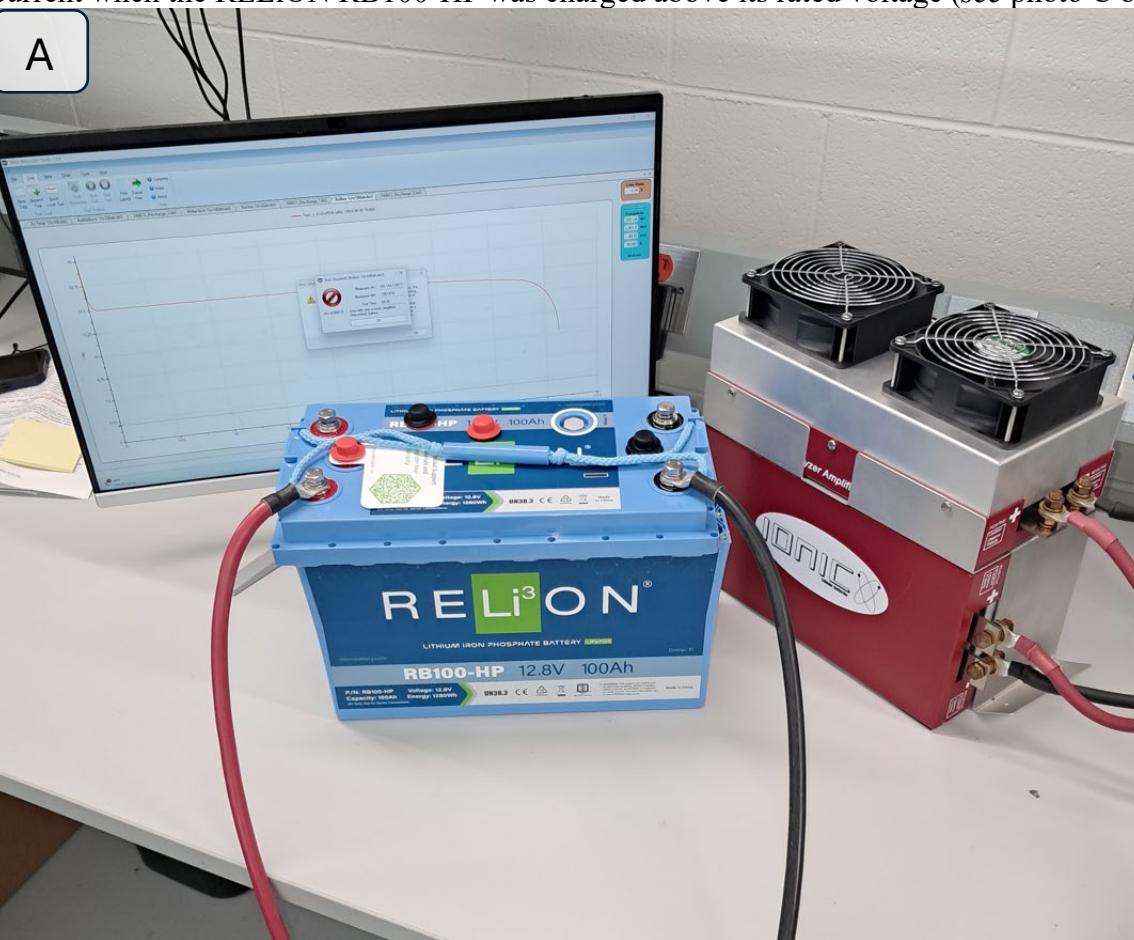
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	<p>Each such cell of the RELiON RB100-HP has a positive pole and a negative pole.</p>  <p>Additionally, for example, the polarity of each unit in a cell of the RELiON RB100-HP was demonstrated as having a positive pole and a negative pole by using a multimeter to measure a voltage potential across the positive pole and a negative pole of a cell.</p>

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	
[14c-i] a circuit board within said housing having a cutoff function incorporated therein,	The RELiON RB100-HP comprises a circuit board within the housing.

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
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Recommended Charge Voltage	14.4 - 14.8 V	DISCHARGE SPECIFICATIONS		BMS Charge Voltage Cut-Off		Maximum Continuous Discharge Current	100 A	15.4 V (3.85 ± 0.025 vpc) (±0.2 s)		Maximum Discharge Current	800 Amps	Reconnect Voltage	14.6 V (3.65 ± 0.05 vpc)	Lithium Marine Cranking Amp (MCA)	Up to 800 Amps for 8 seconds @ 20°F (-6.7°C)	Balancing Voltage	14.4 V (3.6 ± 0.025 vpc)	Discharge Over-Current Protection	1000 A ±100 A (2.2 ± 1 ms)	COMPLIANCE SPECIFICATIONS		Recommended Low Voltage Disconnect	11.0 V	Certifications	UN 38.3, CE & UKCA (battery) UL1642 (cells) (File# MH-162098) IEC62133 (cells)	Discharge Under-Voltage Protection	9.2 V (2.3 ± 0.08 vpc) (4.2 ± 0.5 s)	Shipping Classification	UN 3480, CLASS 9	Reconnect Voltage	10.0 V (2.5 ± 0.1 vpc)	DIMENSIONAL SPECIFICATIONS		Short Circuit Protection Response Time	200-600 µs	 <p>Technical drawing showing the dimensions of the RB100-HP battery. The top view shows a width of 329 (89) mm and a height of 214.7 (52.9) mm. 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https://ceb8596f236225acd007-8e95328c173a04ed694af83ee4e24c15.ssl.cf5.rackcdn.com/docs/product/RELiON-Data-Sheet_RB100-HP.pdf (annotated).

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	<p>For example, as demonstrated by connecting the battery terminals of the RELiON RB100-HP to a computerized battery analyzer (see photo A below), the cutoff functionality is demonstrated by the termination of electrical current when the RELiON RB100-HP was discharged below its rated voltage (see photo B below). Similarly, the cutoff functionality is also demonstrated by the termination of electrical current when the RELiON RB100-HP was charged above its rated voltage (see photo C below).</p> <div style="display: flex; align-items: center;"> A  </div>

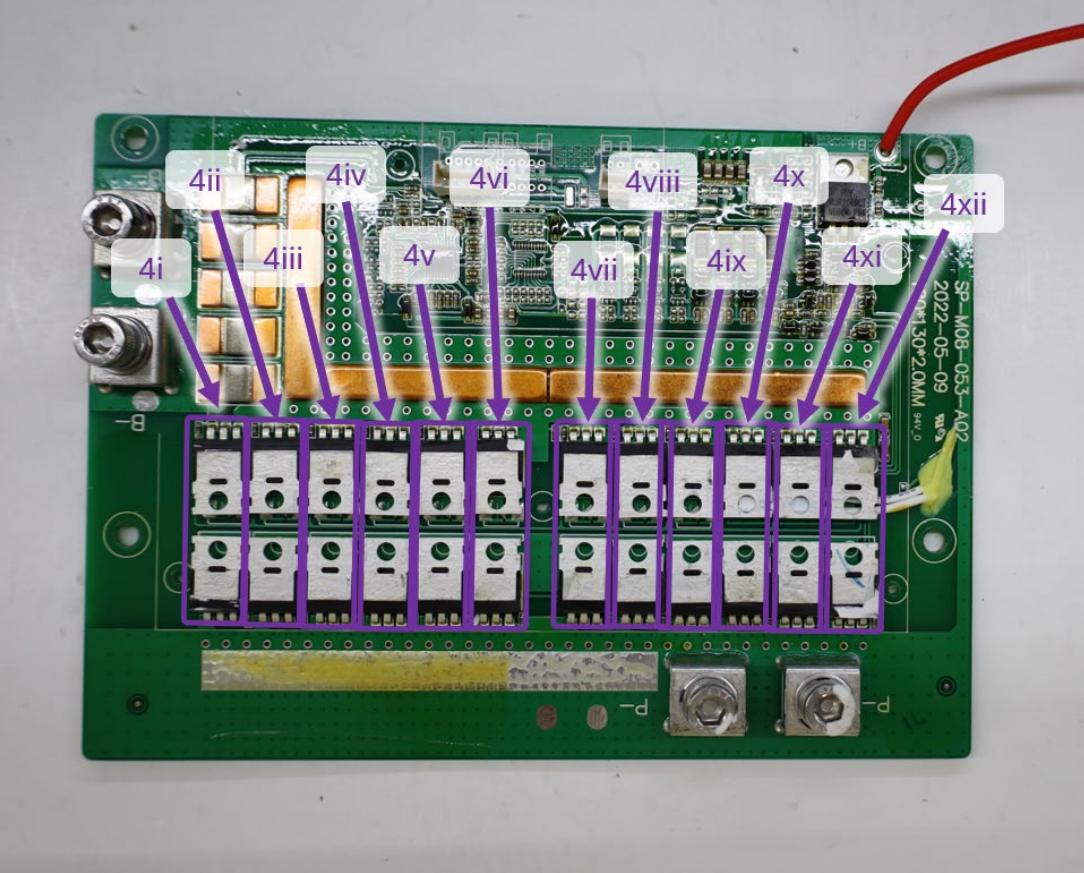
US9,412,994 Claim Element | **RELiON (RELiON RB100-HP)**

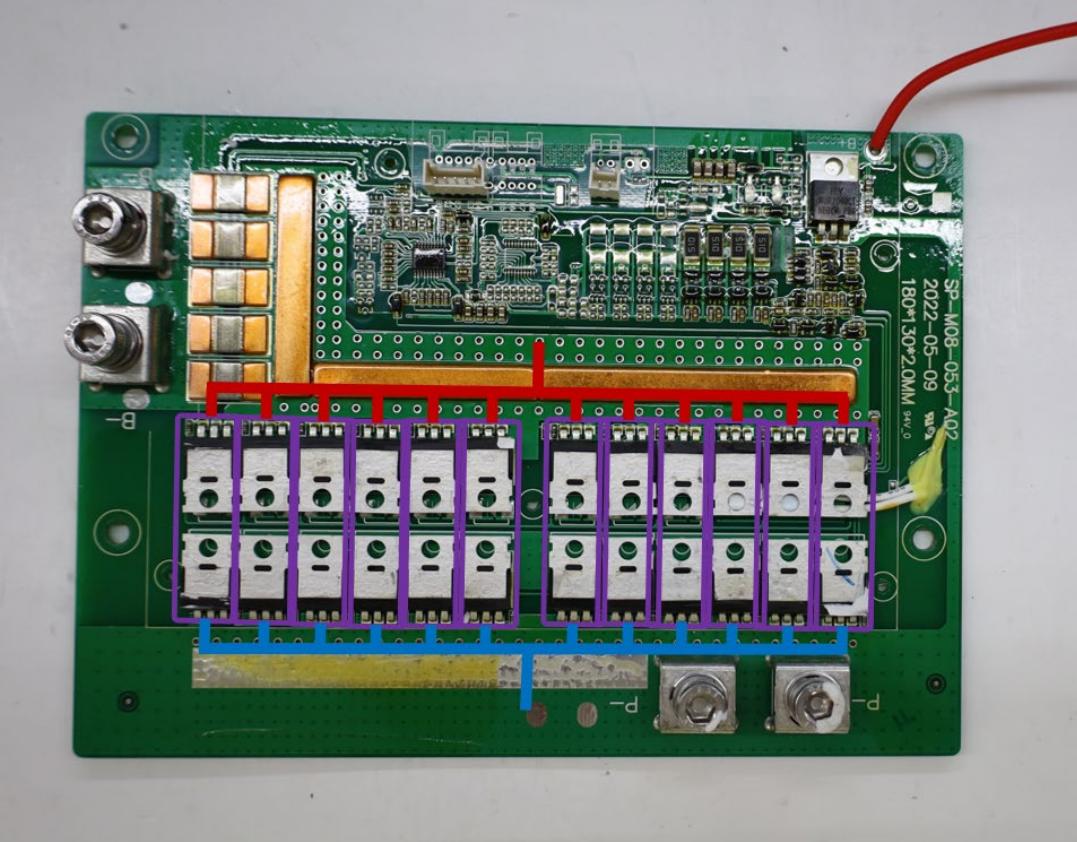
B

C

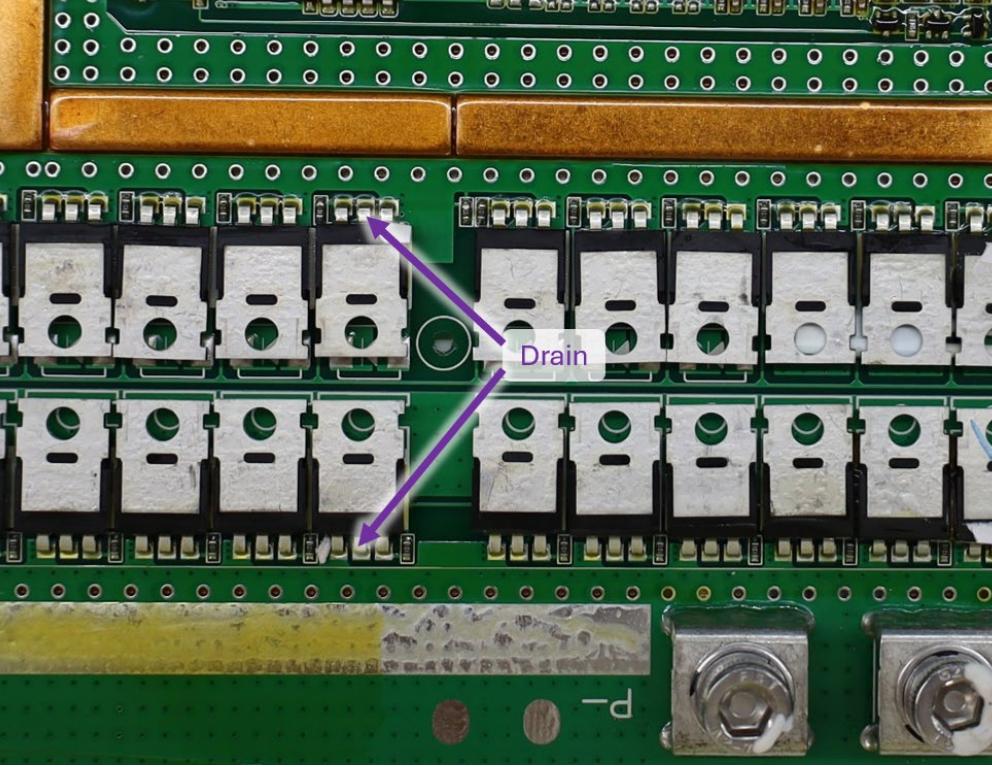
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
<p>[14c-ii] said circuit board including a plurality of pairs of solid state switches with each pair of solid state switches connected in a parallel configuration to another pair of solid state switches,</p>	<p>The circuit board of the RELiON RB100-HP includes a plurality of pairs of solid state switches with each pair of solid state switches connected in a parallel configuration to another pair of solid state switches.</p> 

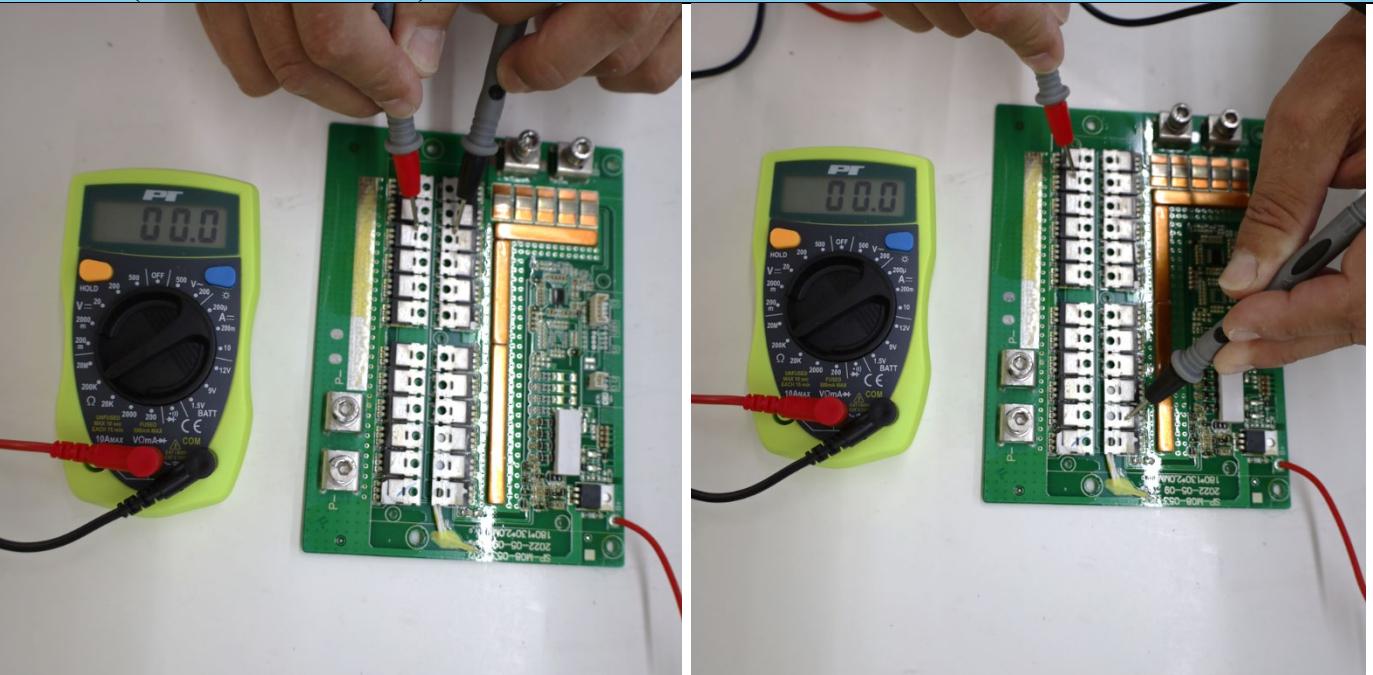
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)												
	<p>International IR Rectifier</p> <p>StrongIRFET™ IRFB7434PbF HEXFET® Power MOSFET</p> <p>PD-96436</p> <p>Applications</p> <ul style="list-style-type: none"> Brushed Motor drive applications BLDC Motor drive applications Battery powered circuits Half-bridge and full-bridge topologies Synchronous rectifier applications Resonant mode power supplies OR-ing and redundant power switches DC/DC and AC/DC converters DC/AC Inverters <p>Benefits</p> <ul style="list-style-type: none"> Improved Gate, Avalanche and Dynamic dV/dt Ruggedness Fully Characterized Capacitance and Avalanche SOA Enhanced body diode dV/dt and dI/dt Capability Lead-Free <p>IRFB7434PbF Datasheet</p> <p>IRFB7434PbF Pinout</p> <p>Ordering Information</p> <table border="1"> <thead> <tr> <th rowspan="2">Base part number</th> <th rowspan="2">Package Type</th> <th colspan="2">Standard Pack</th> <th rowspan="2">Complete Part Number</th> </tr> <tr> <th>Form</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td>IRFB7434PbF</td> <td>TO-220</td> <td>Tube</td> <td>50</td> <td>IRFB7434PbF</td> </tr> </tbody> </table> <p>Fig 1. Typical On-Resistance vs. Gate Voltage</p> <p>Fig 2. Maximum Drain Current vs. Case Temperature</p> <p>http://www.irf.ru/pdf/irfb7434pbf.pdf (annotated).</p> <p>The solid state switches of the RELiON RB100-HP are arranged in pairs (e.g., 4i-4xii) with each pair of solid state switches connected in a parallel configuration to another pair of solid state switches.</p>	Base part number	Package Type	Standard Pack		Complete Part Number	Form	Quantity	IRFB7434PbF	TO-220	Tube	50	IRFB7434PbF
Base part number	Package Type			Standard Pack			Complete Part Number						
		Form	Quantity										
IRFB7434PbF	TO-220	Tube	50	IRFB7434PbF									

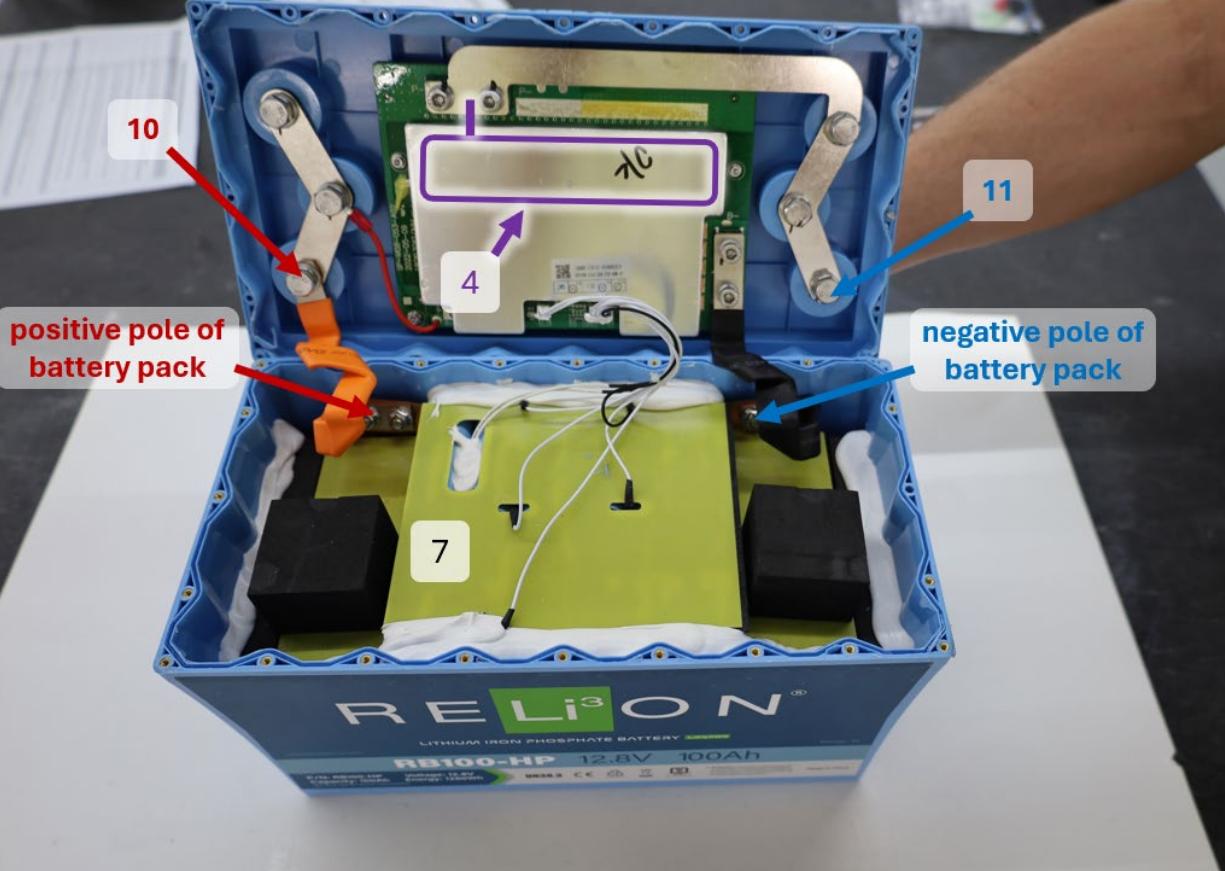
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	

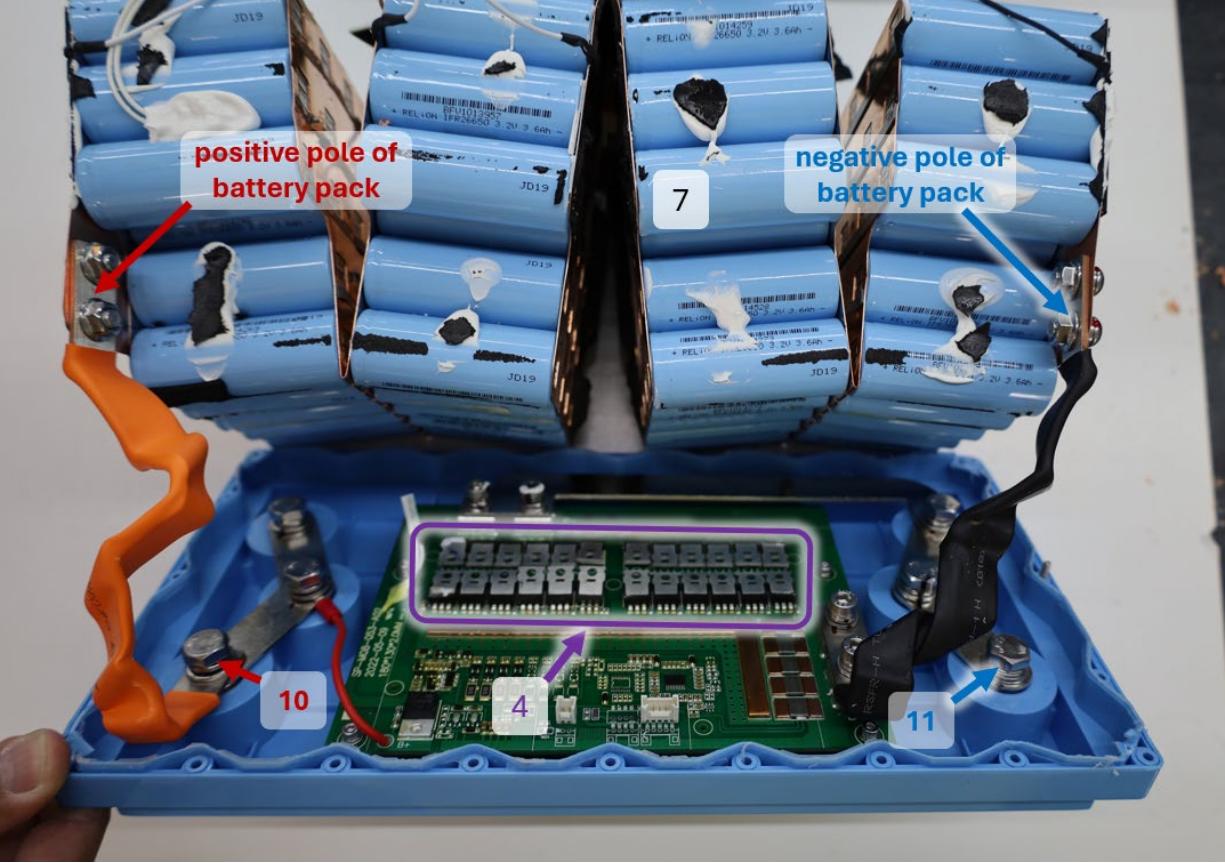
US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
<p>[14c-iii] each switch having a source and a drain, the switches of a pair of solid state switchers being configured such that either the drains of the switches are connected or the sources of the switches are connected; and</p>	 <p>Each switch of the RELiON RB100-HP has a source (i.e., "S") and a drain (i.e., "D").</p>

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)																		
	<p>International Rectifier</p> <p>StrongIRFET™</p> <p>IRFB7434PbF HEXFET® Power MOSFET</p> <p>PD - 96436</p> <p>Applications</p> <ul style="list-style-type: none"> Brushed Motor drive applications BLDC Motor drive applications Battery powered circuits Half-bridge and full-bridge topologies Synchronous rectifier applications Resonant mode power supplies OR-ing and redundant power switches DC/DC and AC/DC converters DC/AC Inverters <p>Benefits</p> <ul style="list-style-type: none"> Improved Gate, Avalanche and Dynamic dV/dt Ruggedness Fully Characterized Capacitance and Avalanche SOA Enhanced body diode dV/dt and dI/dt Capability Lead-Free <p>IRFB7434PbF</p> <p>TO-220AB IRFB7434PbF</p> <p>Pinout:</p> <table border="1"> <tr> <td>G</td> <td>D</td> <td>S</td> </tr> <tr> <td>Gate</td> <td>Drain</td> <td>Source</td> </tr> </table> <p>Ordering Information</p> <table border="1"> <thead> <tr> <th rowspan="2">Base part number</th> <th rowspan="2">Package Type</th> <th colspan="2">Standard Pack</th> <th rowspan="2">Complete Part Number</th> </tr> <tr> <th>Form</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td>IRFB7434PbF</td> <td>TO-220</td> <td>Tube</td> <td>50</td> <td>IRFB7434PbF</td> </tr> </tbody> </table> <p>Fig 1. Typical On-Resistance vs. Gate Voltage www.irf.com</p> <p>Fig 2. Maximum Drain Current vs. Case Temperature</p> <p>http://www.irf.ru/pdf/irfb7434pbf.pdf (annotated).</p> <p>The switches of a pair of solid state switches of the RELiON RB100-HP are configured such that the drains of the switches are connected.</p>	G	D	S	Gate	Drain	Source	Base part number	Package Type	Standard Pack		Complete Part Number	Form	Quantity	IRFB7434PbF	TO-220	Tube	50	IRFB7434PbF
G	D	S																	
Gate	Drain	Source																	
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		Form	Quantity																
IRFB7434PbF	TO-220	Tube	50	IRFB7434PbF															

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	 <p>For example, as demonstrated by testing the electrical continuity using a multimeter, the drains of the switches of the RELiON RB100-HP are connected, as shown by the nominal resistance measured between the drains of opposed MOSFETs.</p>

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
<p>[14d] said parallel configuration of the plurality of solid state switches (4) being connected in series with said one or more cells (7) between said positive (10) and negative terminals (11) of the battery pack.</p>	 <p>The RELiON RB100-HP includes said parallel configuration of the plurality of solid state switches (4) being connected in series with said one or more cells (7) between said positive (10) and negative terminals (11) of the battery pack.</p>

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	 <p>positive pole of battery pack</p> <p>negative pole of battery pack</p> <p>4</p> <p>7</p> <p>10</p> <p>11</p>

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	

US9,412,994 Claim Element	RELiON (RELiON RB100-HP)
	